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

Soil Survey of Whitley County, Indiana

How To Use This Soil Survey

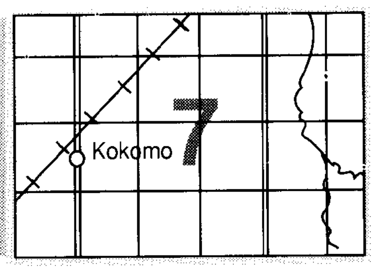
General Soil Map

The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

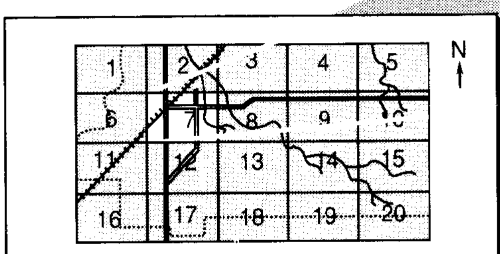
Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.



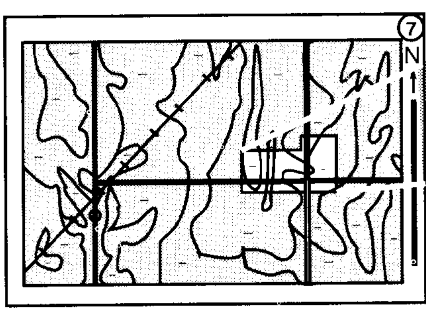
MAP SHEET

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.

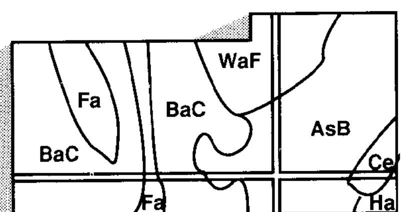


INDEX TO MAP SHEETS

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



MAP SHEET



AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

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, handicap, or age.

Major fieldwork for this soil survey was completed in 1983. Soil names and descriptions were approved in 1985. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1983. This survey was made cooperatively by the Soil Conservation Service, the Purdue University Agricultural Experiment Station, and the Indiana Department of Natural Resources, Soil and Water Conservation Committee. It is part of the technical assistance furnished to the Whitley County Soil and Water Conservation District. Financial assistance was made available by the Whitley County Commissioners.

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.

Cover: Hay in an area of Glynwood and Morley soils.

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Soil Series

Issued March 1990

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Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Whitley County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, 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 ensure 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 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 Whitley County in Indiana.

Soil Survey of Whitley County, Indiana

By Donald R. Ruesch, Soil Conservation Service

Fieldwork by Donald R. Ruesch, Soil Conservation Service, and
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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

WHITLEY COUNTY is in the northeastern part of Indiana. It became an independent political entity on April 1, 1838 (*3*). It has an area of 216,211 acres, or about 338 square miles. Columbia City, the county seat, is in the central part of the county. The population of the county is about 25,000.

About 178,300 acres in the county is farmland. Of this acreage, about 149,000 acres is cropland, 1,600 acres is permanent pasture, 15,300 acres is woodland, and 12,400 acres is used for other purposes (*7*). Growing cash grain and raising livestock are the major types of farming. Corn, soybeans, and winter wheat are the major crops. Specialty crops are grown in some areas. Hogs and cattle are the major kinds of livestock. The county has a few dairy and poultry farms.

General Nature of the County

This section gives general information concerning Whitley County. It describes physiography, relief, and drainage; climate; water supply; transportation facilities; and trends in population and land use.

Physiography, Relief, and Drainage

The highest points in the county are more than 990 feet above sea level. One of these is at the west edge of Thorncreek Township, and the other is 0.75 mile northwest of Larwill. The lowest point is 750 feet above sea level. It is in the southeast corner of the county.

More than two-thirds of the county is drained by the Eel River. A small area in the northwestern part, however, is drained by the Tippecanoe River, and a small area in the southeastern part is drained by the Wabash River.

The Eel River divides the county into two major physiographic regions. The landscape south of the river generally is one of nearly level to gently rolling glacial till plains and low moraines. The soils are dominantly somewhat poorly drained, very poorly drained, and moderately well drained and formed in clay loam glacial till. The surface drainage pattern is poorly defined in some areas. Excess water is removed from the soils by open ditches and subsurface drains.

The landscape north of the Eel River generally is one of rolling to steep hills on moraines and of deep depressions between the moraines. The soils are dominantly well drained or very poorly drained and formed in many kinds of material, including loamy glacial till, sandy and gravelly outwash, lacustrine deposits, and organic deposits. The surface drainage pattern is poorly defined in the depressional areas. Excess water is removed from the soils by open ditches and subsurface drains. In many areas adequate outlets for subsurface drains are not readily available.

The Eel River is bordered by nearly level bottom land and river terraces. The soils on the terraces are dominantly well drained and formed in outwash of sand and gravel. Many are moderately droughty. The soils on the bottom land are dominantly very poorly drained and somewhat poorly drained and formed in alluvial deposits. They are subject to flooding.

Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Whitley 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 thus minimizes summer drought on most soils. The normal annual precipitation is adequate for all of the crops that are suited to the temperature and growing season in the county.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Columbia City, Indiana, in the period 1963 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 26 degrees F, and the average daily minimum temperature is 17 degrees. The lowest temperature on record, which occurred at Columbia City on January 21, 1970, is -18 degrees. In summer the average temperature is 70 degrees, and the average daily maximum temperature is 81 degrees. The highest recorded temperature, which occurred on June 29, 1971, is 98 degrees.

Growing degrees days are shown in table 1. They 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.

The total annual precipitation is nearly 38 inches. Of this, about 22 inches, or nearly 60 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 20 inches. The heaviest 1-day rainfall during the period of record was 3.19 inches at Columbia City on May 16, 1968. Thunderstorms occur on about 40 days each year. Tornadoes and severe thunderstorms occur occasionally. These storms are usually local in extent and of short duration and cause damage in scattered areas.

The average seasonal snowfall is about 30 inches. The greatest snow depth at any one time during the period of record was 13 inches. On the average, 14 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible in summer and 40 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, 12 miles per hour, in spring.

Water Supply

The Eel River is the largest stream in Whitley County. It flows across the county from the northeast to the southwest. The Blue River flows from the northeast corner of the county to a point about 2 miles south of Columbia City, where it joins the Eel River. Part of the Eel River and much of Blue River were dredged in the early 1900's. Indian, Big Indian, Calf, and Clear Creeks are tributaries of the Wabash River in the southern part of the county. The Tippecanoe River begins in Big Lake and passes through only a few miles of Whitley County before entering Noble County to the north. At its point of departure from the county, this stream is less than 10 feet wide.

The county has 20 freshwater lakes 10 acres or larger in size. The lakes are of glacial origin. They are north of the Eel River.

Ground water in Whitley County is available mainly from glacial deposits but also from bedrock aquifers. The county is divided into three ground-water provinces. One of these is the moraine area north of the Eel River, and another is the area of plains south of the Eel River. The third province is the valley of the Eel River and the preglacial valley that it follows.

In the moraine area, more than 95 percent of the wells are in deposits of sand and gravel. The average depth of these wells is between 75 and 100 feet. The water levels are relatively high, ranging from 10 to 30 feet below the surface. Yields from domestic wells are more than adequate. Large-diameter wells can be expected to yield 200 gallons per minute or more.

In the southern province, the bedrock formations are closer to the surface than those in the moraine area and the glacial drift was deposited under conditions less favorable for the accumulation of large deposits of sand and gravel. The water levels commonly are as low as 70 feet below the surface and seldom are higher than 40 feet. Only about 50 percent of the wells in this province are in deposits of sand and gravel. The average depth of these wells is more than 100 feet. The rest of the wells in this province are dug into limestone bedrock and average between 200 and 250 feet deep. Four-inch wells in the bedrock yield between 15 and 30 gallons per minute. Larger diameter wells can be expected to yield as much as 100 gallons per minute.

The valley of the Eel River and the preglacial valley with which it is associated have outwash deposits of mainly sand and gravel. These deposits are thicker, cleaner, and coarser textured than those in the other two provinces. As a result, yields in this province can be expected to be much greater, perhaps as high as 1,000 gallons per minute from large-diameter wells.

Transportation Facilities

Whitley County has 139 miles of highways and 771 miles of county roads. More than two-thirds of the county roads are paved.

Two railroads serve the county. Both of them run from east to west. One crosses the central part of the county, and the other crosses the southern part. The county has several private landing strips, but it does not have an airport.

Trends in Population and Land Use

Whitley County has a population of about 25,000 and a population density of about 75 people per square mile. The population increased about 11 percent between 1950 and 1960, by 11 percent between 1960 and 1970, and by 7 percent between 1970 and 1980.

During the period 1974 to 1982, the total acreage of farmland decreased by more than 7 percent, from about 192,700 to about 178,300 acres. During the same period, the total acreage used for harvested grain crops increased by about 4 percent, from about 132,000 to 137,100 acres (*6, 7*). The decrease in the acreage of farmland results from an increase in the acreage developed for urban, industrial, transportation, and recreational uses. The acreage used for harvested grain crops increased because of an increase in the number of confinement feeding systems for livestock. The use of these systems allows the farmers to clear woodlots, remove fence rows, and convert pasture to cropland.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; and the kinds of crops and native plants growing on the soils. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another 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 association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The names, descriptions, and delineations of the soils identified on the general soil map of this county do not always agree or join fully with those of the soils identified on the maps of adjoining counties published at an earlier date. Some differences are the result of changes in concepts of soil series. Other differences result from variations in the extent of the soils. Others are the result of variations in the slope range allowed in the associations.

Soil Descriptions

1. Miami-Wawasee-Riddles Association

Gently sloping to moderately steep, well drained soils formed in glacial till; on moraines

This association is on hills and ridges and in depressions. Marshes are in the deeper depressions. Slopes range from 1 to 25 percent.

This association makes up about 3 percent of the county. It is about 45 percent Miami soils, 12 percent Wawasee soils, 11 percent Riddles soils, and 32 percent minor soils (fig. 1).

Miami soils are gently sloping to moderately steep. Typically, the surface layer is dark grayish brown sandy loam in eroded areas and dark yellowish brown clay loam in severely eroded areas. The subsoil is yellowish brown and dark yellowish brown clay loam and loam.

Wawasee soils are gently sloping and moderately sloping. Typically, the surface layer is dark grayish brown sandy loam. The subsoil is yellowish brown loam and clay loam.

Riddles soils are gently sloping and moderately sloping. Typically, the surface layer is dark brown sandy loam. The subsoil is yellowish brown and dark yellowish brown clay loam and loam.

Minor in this association are the Boyer, Brookston, Coesse, Crosier, Houghton, Martinsville, Rensselaer, Sebewa, Seward, and Spinks soils. The well drained Boyer and Martinsville soils are on knobs and ridges around some of the deep depressions. The moderately well drained Seward and well drained Spinks soils are on ridges. They are more sandy than the major soils. The somewhat poorly drained Crosier soils are in nearly level areas. The very poorly drained Brookston, Coesse, Houghton, Rensselaer, and Sebewa soils are in depressions.

Most areas are used for cultivated crops. Some are used for hay or pasture. This association is fairly well suited to corn, soybeans, and wheat. It is well suited to legumes, such as alfalfa and red clover. Erosion is the major hazard on the more sloping soils. Erosion-control measures are needed if cultivated crops are grown.

Several areas are used as woodlots. The major soils are well suited to trees. If the woodland is managed properly, excellent hardwood timber can be grown. The very poorly drained minor soils support water-tolerant trees. The wetness of these soils limits the use of logging equipment. The woodlots provide good habitat for woodland wildlife.

Most of the gently sloping and moderately sloping areas of the major soils are suitable as sites for buildings and septic tank absorption fields. The shrink-swell of the Miami and Riddles soils is a moderate limitation on sites for buildings. Some areas are severely limited as sites for urban uses because of the slope. The minor soils in depressional areas are generally unsuited to these uses because of ponding.

This association is fairly well suited to intensive recreational uses. The slope is the major limitation. Land leveling is needed in many areas.

2. Morley-Rawson Association

Nearly level to steep, well drained and moderately well drained soils formed in glacial till and in loamy outwash over glacial till; on till plains and moraines

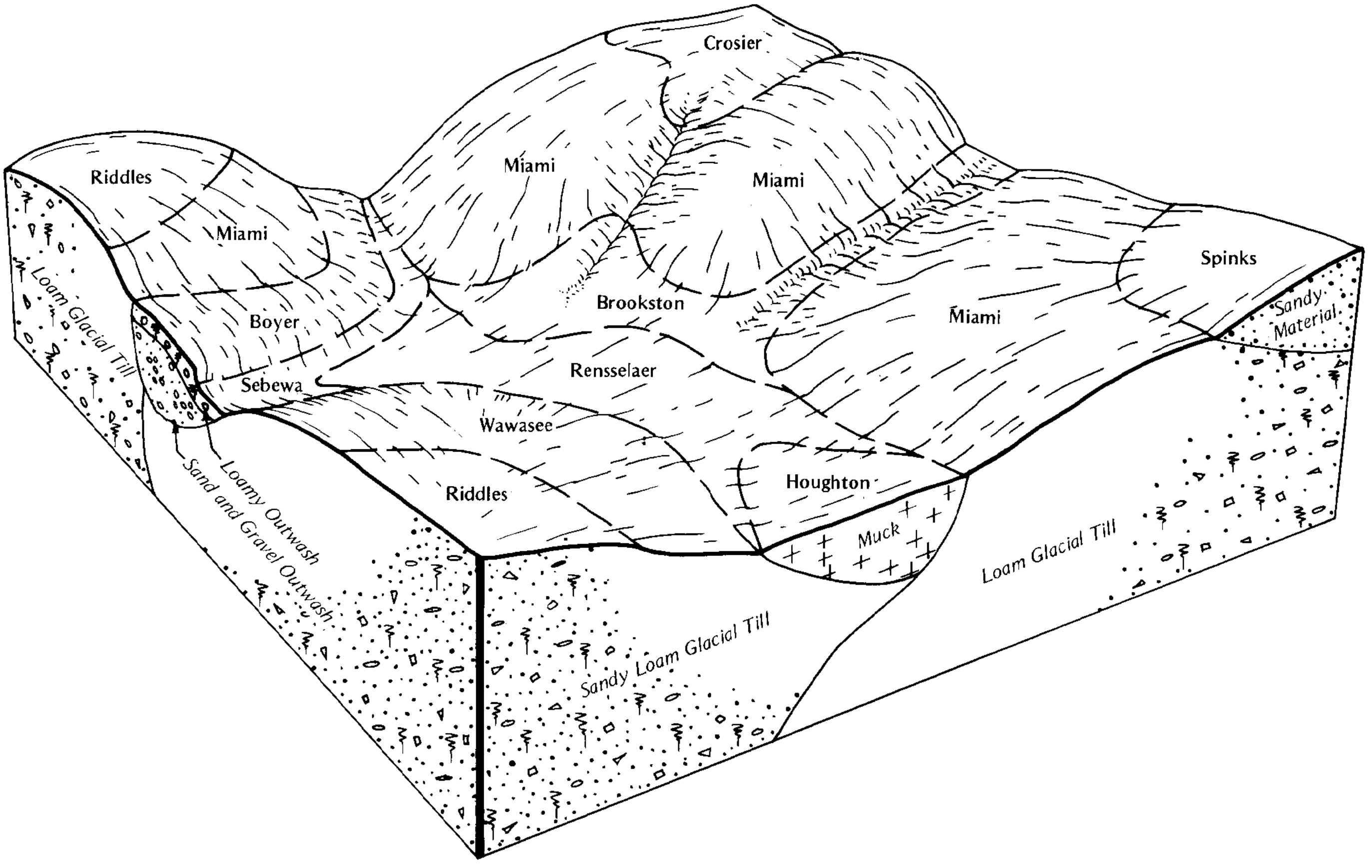

Figure 1.—Pattern of soils and parent material in the Miami-Wawasee-Riddles association.

This association is on hills and ridges and in ravines and depressions. Lakes and marshes are in the deeper depressions. Slopes range from 0 to 30 percent.

This association makes up about 12 percent of the county. It is about 45 percent Morley soils, 13 percent Rawson soils, and 42 percent minor soils (fig. 2).

Morley soils are gently sloping to steep. They are well drained. Typically, the surface layer is dark grayish brown loam in eroded areas and dark brown clay loam in severely eroded areas. The subsoil is dark yellowish brown and yellowish brown clay and clay loam.

Rawson soils are nearly level to moderately sloping. They are moderately well drained. Typically, the surface layer is dark grayish brown sandy loam. The subsoil is yellowish brown, dark brown, and dark yellowish brown sandy loam and sandy clay loam in the upper part and yellowish brown, mottled clay and clay loam in the lower part.

Minor in this association are the Blount, Coesse, Glynwood, Haskins, Houghton, Muskego, Pewamo, and Seward soils. The somewhat poorly drained Blount and Haskins soils are on foot slopes and in nearly level areas. The moderately well drained Glynwood and Seward soils are on gently rolling hills. Seward soils are more sandy than the major soils. The very poorly drained Houghton and Muskego soils are in deep depressions. The very poorly drained Coesse and Pewamo soils are in narrow depressions.

Most areas are used for cultivated crops. Some are used for hay and pasture. This association is fairly well suited to corn, soybeans, and wheat. Erosion is the major hazard. Erosion-control measures are needed if cultivated crops are grown. Many of the deep depressions cannot be easily drained. The well drained and moderately well drained soils are well suited to legumes, such as alfalfa and red clover.

Several areas are used as woodlots. The major soils are well suited to trees. If the woodland is managed properly, excellent hardwood timber can be grown. The very poorly drained minor soils support water-tolerant trees. The wetness of these soils limits the use of logging equipment. The woodlots provide good habitat for woodland wildlife.

This association is fairly well suited to residential development. The shrink-swell potential of both the

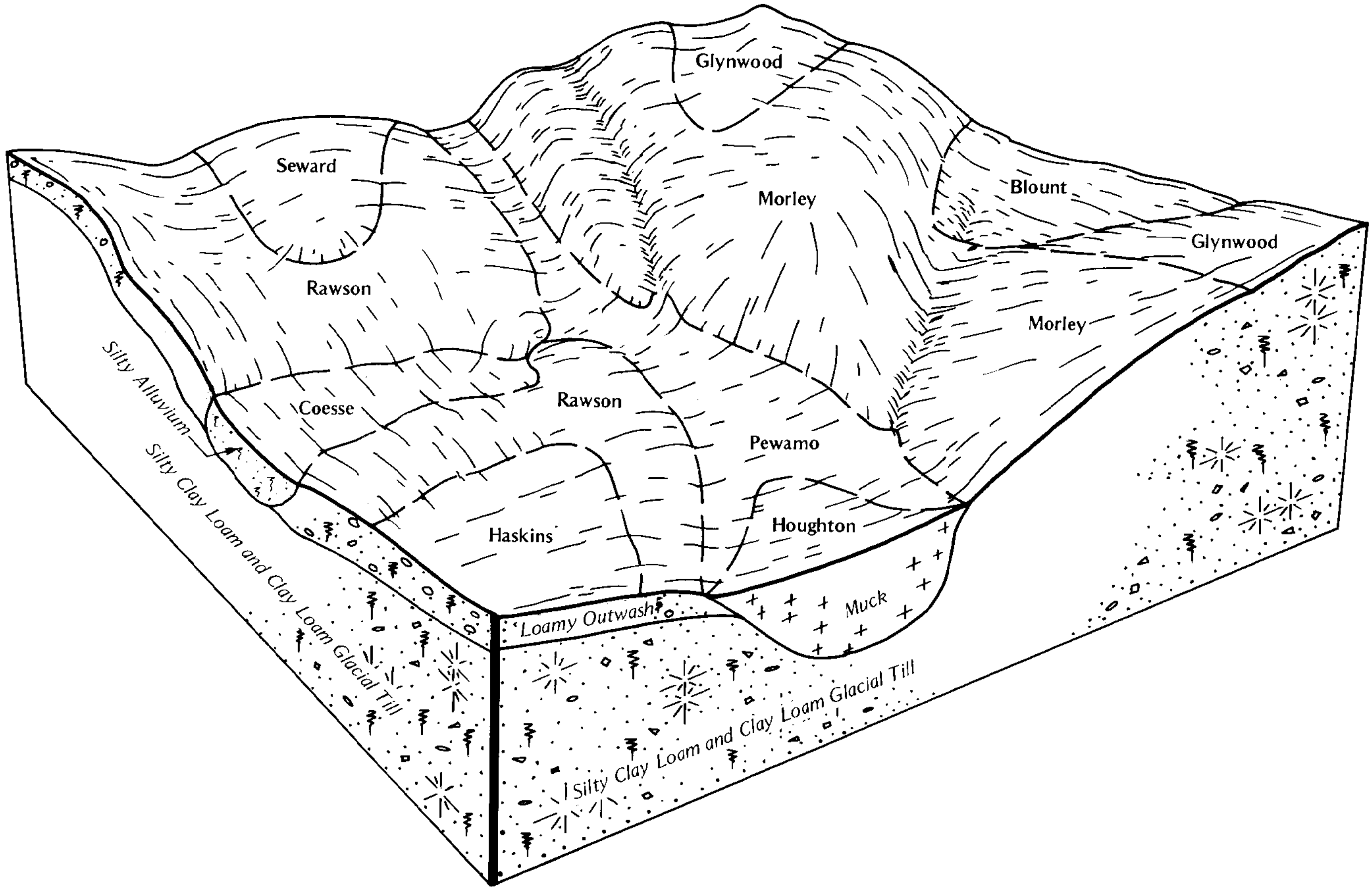

Figure 2.—Pattern of soils and parent material in the Morley-Rawson association.

major soils and the wetness of the Rawson soil are moderate limitations on sites for buildings. Also, the slope is a limitation in some areas. Most areas are severely limited as sites for septic tank absorption fields because of slope, slow permeability, or wetness. The minor soils in depressional areas are generally unsuited to urban uses because of ponding.

This association is fairly well suited to intensive recreational uses. The slope and the slow permeability are the major limitations. Land leveling is needed in many areas.

3. Morley-Glynwood Association

Gently sloping to steep, well drained and moderately well drained soils formed in glacial till; on till plains and moraines

This association is on hills and ridges and in ravines and depressions. Lakes and marshes are in the deeper depressions. Slopes range from 3 to 30 percent.

This association makes up about 27 percent of the county. It is about 51 percent Morley soils, 9 percent Glynwood soils, and 40 percent minor soils.

Morley soils are gently sloping to steep. They are well drained. Typically, the surface layer is dark grayish brown loam in eroded areas and dark brown clay loam in severely eroded areas. The subsoil is dark yellowish brown and yellowish brown clay and clay loam.

Glynwood soils are gently sloping and moderately sloping. They are moderately well drained. Typically, the surface layer is dark grayish brown loam in eroded areas and dark yellowish brown clay loam in severely eroded areas. The subsoil is dark yellowish brown, mottled clay.

Minor in this association are the Blount, Hennepin, Houghton, Martisco, Milford, Pewamo, Rawson, and Seward soils. The somewhat poorly drained Blount soils are in nearly level areas. The well drained Hennepin soils are on steep side slopes and in ravines. They are less clayey than the major soils. The very poorly drained Houghton, Martisco, Milford, and Pewamo soils are in depressions. The moderately well drained Rawson and

Seward soils are on gently rolling knobs and ridges. They are more sandy than the major soils.

Most areas are used for cultivated crops. Many are used for hay and pasture. This association is fairly well suited to corn, soybeans, and wheat. Erosion is the major hazard. Erosion-control measures are needed if cultivated crops are grown. Many of the deep depressions cannot be easily drained. The well drained and moderately well drained soils are well suited to legumes, such as alfalfa and red clover.

Some areas are used as woodlots. The major soils are well suited to trees. If the woodland is managed properly, excellent hardwood timber can be grown. The very poorly drained minor soils support water-tolerant trees. The wetness of these soils limits the use of logging equipment. The woodlots provide good habitat for woodland wildlife.

This association is fairly well suited to residential development. The shrink-swell potential of both the major soils and the wetness of the Glynwood soils are moderate limitations on sites for buildings. Also, the slope is a limitation in some areas. Most areas are severely limited as sites for septic tank absorption fields because of slope, slow permeability, or wetness. The minor soils in depressional areas are generally unsuited to urban uses because of ponding.

This association is fairly well suited to intensive recreational uses. The slope and the slow permeability are the major limitations. Land leveling is needed in many areas.

4. Blount-Pewamo-Glynwood Association

Nearly level to moderately sloping, somewhat poorly drained, very poorly drained, and moderately well drained soils formed in glacial till; on till plains and moraines

This association is in areas of slight swells and swales. The surface drainage pattern is fairly well defined, but depressions are ponded during wet periods. Slopes range from 0 to 8 percent.

This association makes up about 52 percent of the county. It is about 37 percent Blount soils, 20 percent Pewamo soils, 14 percent Glynwood soils, and 29 percent minor soils (fig. 3).

Blount soils are nearly level and gently sloping. They are somewhat poorly drained. Typically, the surface layer is dark grayish brown silt loam. The subsoil is dark yellowish brown and yellowish brown, mottled clay and clay loam.

Pewamo soils are nearly level and very poorly drained. Typically, the surface layer is very dark gray silty clay loam. The subsoil is dark gray and gray, mottled clay, silty clay loam, and clay loam.

Glynwood soils are gently sloping and moderately sloping. They are moderately well drained. Typically, the surface layer is dark grayish brown loam in eroded areas and dark yellowish brown clay loam in severely eroded areas. The subsoil is dark yellowish brown, mottled clay.

Minor in this association are the Haskins, Mermill, Milford, Morley, Rawson, and Shoals soils. The somewhat poorly drained Haskins soils are in nearly level areas. They are more sandy than the major soils. The very poorly drained Mermill and Milford soils are in depressional areas. Milford soils are more clayey than the major soils and are stratified in the lower part of the subsoil. The well drained Morley soils are on the steeper slopes. The moderately well drained Rawson soils are on low ridges and foot slopes. They are more sandy than the major soils. The somewhat poorly drained Shoals soils are on narrow bottom land. They are less clayey than the major soils.

Most areas are used for cultivated crops. A few are used for hay or pasture. This association is well suited to corn and soybeans. Wetness is the major limitation on the nearly level Pewamo and Blount soils. Subsurface drains have been installed in most of the depressions and drainageways. Erosion is the major hazard if the gently sloping or moderately sloping Glynwood and Blount soils are used for cultivated crops. If drained, the Glynwood and Blount soils are suited to legumes, but the Pewamo soils are poorly suited because of ponding.

Some areas are used as woodlots. The woodlots are small and generally are in the steeper areas or in deep depressions. Many are being cleared for cultivation. This association is fairly well suited to trees. Water-tolerant species should be selected for planting on the very poorly drained soils in depressional areas. The wetness in these areas limits the use of logging equipment.

This association is poorly suited to residential development. Wetness and restricted permeability are severe limitations on sites for septic tank absorption fields. The wetness and a moderate shrink-swell potential are limitations on sites for dwellings. The minor soils in depressional areas are generally unsuited to urban uses because of ponding.

This association is fairly well suited to intensive recreational uses. The wetness and the restricted permeability are the major limitations. A subsurface drainage system is needed.

5. Boyer-Shoals-Kalamazoo Association

Nearly level to moderately steep, well drained and somewhat poorly drained soils formed in loamy, sandy, and gravelly outwash and in loamy alluvium over sandy and gravelly outwash; on terraces, outwash plains, moraines, and bottom land

This association is on a dominantly nearly level topography broken by breaks between the different levels of terraces and the bottom land. The surface drainage pattern is poorly defined. Depressional areas are ponded during wet periods. Slopes range from 0 to 20 percent.

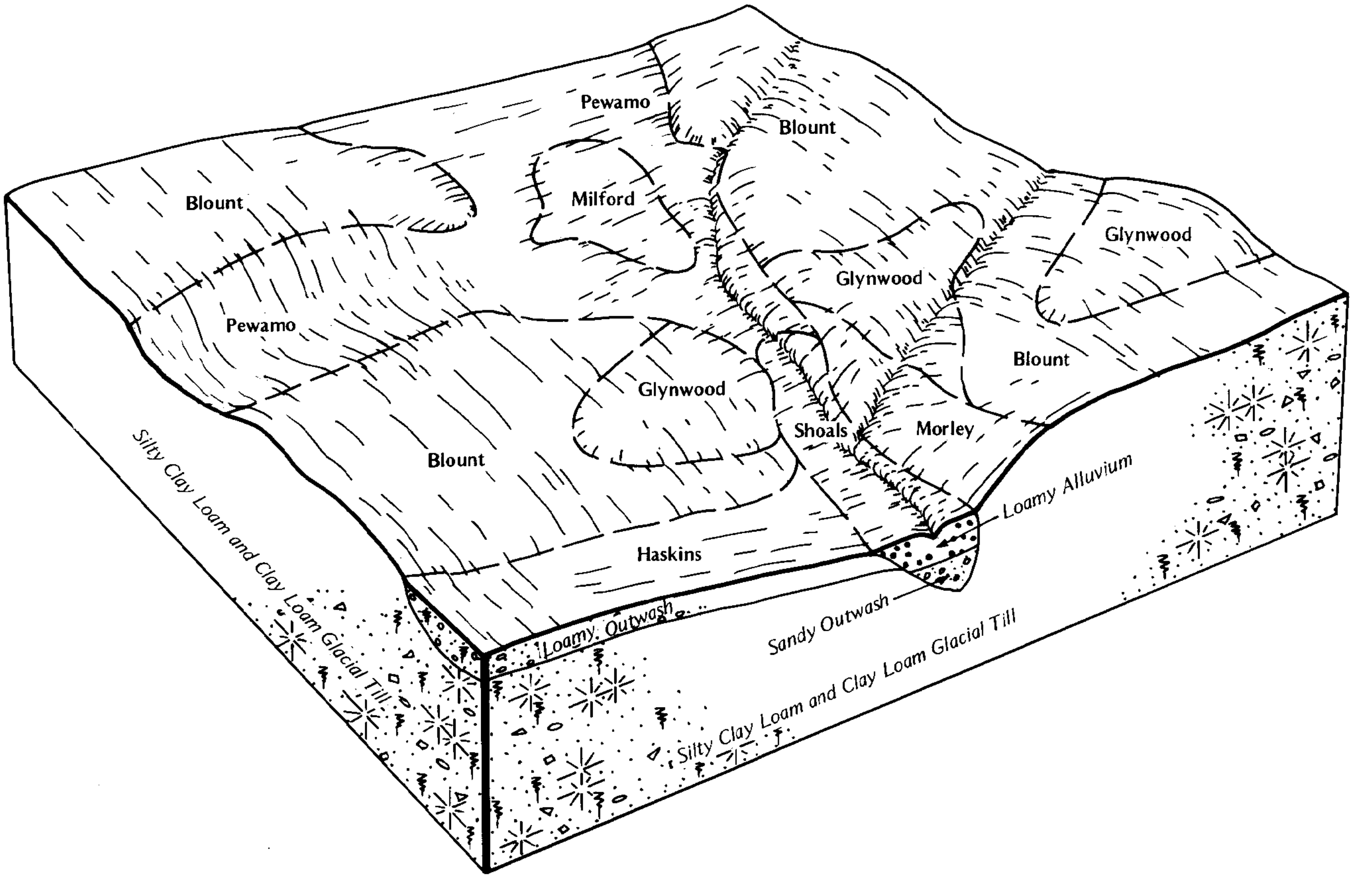

Figure 3.—Pattern of soils and parent material in the Blount-Pewamo-Glynwood association.

This association makes up about 3 percent of the county. It is about 30 percent Boyer soils, 18 percent Shoals soils, 12 percent Kalamazoo soils, and 40 percent minor soils (fig. 4).

Boyer soils are nearly level to moderately steep and are on terraces, outwash plains, and moraines. They are well drained. Typically, the surface layer is dark brown sandy loam in slightly eroded and eroded areas and dark brown loam in severely eroded areas. The subsoil is dark brown gravelly sandy loam and sandy loam.

Shoals soils are nearly level and are on bottom land. They are somewhat poorly drained. Typically, the surface layer is dark grayish brown silt loam. The underlying material is yellowish brown and dark gray, mottled loam and sandy loam in the upper part and grayish brown, mottled sand and gravelly coarse sand in the lower part.

Kalamazoo soils are nearly level and gently sloping and are on terraces, outwash plains, and moraines. They are well drained. Typically, the surface layer is dark brown sandy loam. The subsoil is brown and dark brown sandy loam and gravelly sandy clay loam in the upper part and dark brown gravelly sandy loam in the lower part.

Minor in this association are the Homer, Houghton, Ormas, Oshtemo, Rensselaer, Sebewa, and Sloan soils. The somewhat poorly drained Homer soils are in low areas. The very poorly drained Houghton, Rensselaer, and Sebewa soils are in depressions. The well drained Ormas and Oshtemo soils are on ridges and breaks. They have less clay in the solum than the major soils. The very poorly drained Sloan soils are on bottom land.

Most areas are used for cultivated crops. A few are used for hay or pasture. This association is fairly well suited to corn, soybeans, and wheat. In most areas of the well drained soils, drought is a hazard. Erosion is a hazard in the more sloping areas. Flooding is a hazard on the bottom land. Many of the deep depressions cannot be easily drained. The well drained soils are well suited to legumes, such as alfalfa and red clover.

Some areas are used as woodlots. Most of the woodlots are on the steeper slopes or on the bottom land. The Boyer and Kalamazoo soils are well suited to trees. If the woodland is managed properly, excellent

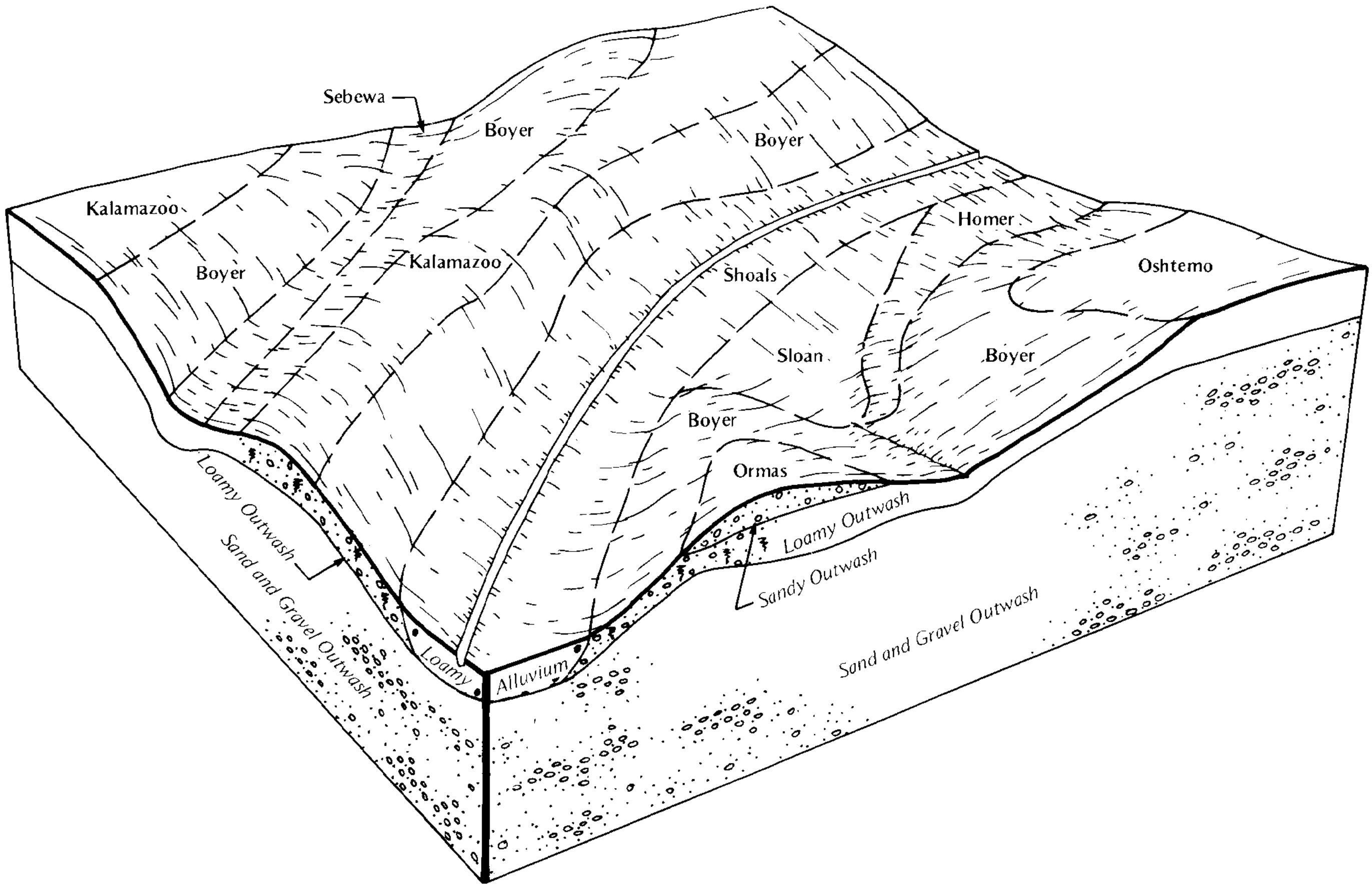

Figure 4.—Pattern of soils and parent material in the Boyer-Shoals-Kalamazoo association.

hardwood timber can be grown on these soils. The Shoals soils are fairly well suited to trees. They support water-tolerant species.

The Boyer and Kalamazoo soils are well suited to building site development. The shrink-swell potential of the Kalamazoo soils and the slope of the steeper Boyer soils are limitations. The Boyer and Kalamazoo soils are severely limited as sites for septic tank absorption fields because of a poor filtering capacity. The Shoals soils are generally unsuited to urban uses because of the flooding.

The Boyer and Kalamazoo soils are well suited to intensive recreational uses, but the Shoals soils are poorly suited because of the flooding.

6. Houghton-Sloan Association

Nearly level, very poorly drained soils formed in organic material and in loamy alluvium over sandy outwash; on moraines, outwash plains, and bottom land

This association is in low areas in old glacial lakebeds and sloughs. The surface drainage pattern is poorly defined. Lakes and marshes are in the deeper depressions. Slopes range from 0 to 2 percent.

This association makes up about 3 percent of the county. It is about 35 percent Houghton and similar soils, 25 percent Sloan and similar soils, and 40 percent minor soils.

Houghton soils are on the bottom of depressions on moraines and outwash plains. Typically, the surface layer is black muck. The subsoil is black and dark reddish brown muck.

Sloan soils are on bottom land along small streams leading into and out of old glacial lakes. Typically, the surface layer is very dark gray loam. The subsoil is dark gray and very dark gray, mottled, stratified sandy loam, silt loam, and loam.

Minor in this association are the Boyer, Mermill, Morley, Sebewa, and Shoals soils. The well drained Boyer soils are on river terraces. The very poorly drained Mermill and Sebewa soils are in the old lakebeds. The well drained Morley soils are on hills. The somewhat poorly drained Shoals soils are on bottom land.

Most areas are used for cultivated crops. A few are used for hay or pasture. This association is fairly well suited to corn, soybeans, and wheat. Wetness is the major limitation, and ponding and flooding are the major hazards. Surface and subsurface drains have been installed in most areas. In many areas, adequate drainage outlets are not readily available. Legumes, such as alfalfa, grow poorly unless the soils are drained.

Areas that cannot be easily drained are used as woodlots. The Houghton soils are poorly suited to trees, and the Sloan soils are fairly well suited. Water-tolerant species should be selected for planting. Windthrow is the major hazard. The wetness limits the use of most logging equipment.

The major soils are generally unsuited to residential development and are poorly suited to intensive recreational uses. The major management concerns are ponding, low strength, and a high organic matter content in areas of the Houghton soils and wetness and flooding in areas of the Sloan soils.

Broad Land Use Considerations

Each year land use changes are made in Whitley County. More than 38,000 acres, or about 18 percent of the total acreage, is developed for nonfarm uses. Changes from farm to nonfarm uses have been taking place at a rate of nearly 1 percent of the total acreage per year. As the demand for land to be developed for residential, commercial, industrial, and recreational uses increases, planning for orderly growth becomes more important. The general soil map is useful in planning an outline of future changes in land use, but it should not be used in the selection of sites for specific structures. In areas where the suitability is good for cultivated crops, the suitability for urban development may be poor.

The Miami-Wawasee-Riddles, Morley-Rawson, and Morley-Glynwood associations are fairly well suited to most uses. They are well suited to woodland. Erosion is a hazard if cultivated crops are grown. Slope is the major limitation affecting urban and recreational uses. Slow permeability in the Morley, Rawson, and Glynwood soils is a limitation on sites for septic tank absorption fields.

The Blount-Pewamo-Glynwood association is well suited to cultivated crops. Wetness is the major limitation. Also, erosion is a hazard in the steeper areas. This association is fairly well suited to woodland. Because of the wetness, windthrow is a hazard and the use of some equipment is limited. The association is poorly suited to urban uses because of the wetness and slow permeability.

The Boyer-Shoals-Kalamazoo association is fairly well suited to cultivated crops. The well drained Boyer and Kalamazoo soils can be droughty. The Shoals soils are subject to flooding. The Boyer and Kalamazoo soils are well suited to woodland, urban development, and recreational uses. The Shoals soils are fairly well suited to woodland. Because of frequent flooding, they are generally unsuited to urban uses and poorly suited to recreational uses.

The Houghton-Sloan association is fairly well suited to cultivated crops. Ponding and flooding are hazards. Mainly because of wetness and the windthrow hazard, the Houghton soils are poorly suited to woodland and the Sloan soils are only fairly well suited. This association is generally unsuited to urban uses and poorly suited to recreational uses, mainly because of flooding on the Sloan soils and ponding, low strength, and a high organic matter content in areas of the Houghton soils.

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 and gives the principal hazards and limitations to be considered in planning for specific uses.

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, salinity, 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, Morley loam, 6 to 12 percent slopes, eroded, is a phase of the Morley 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. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

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

The names, descriptions, and delineations of the soils identified on the detailed soil maps of this county do not always agree or join fully with those of the soils identified on the maps of adjoining counties published at an earlier date. Some differences are the result of changes in concepts of soil series. Other differences result from variations in the extent of the soils. Others are the result of variations in the slope range allowed in the map units.

Table 4 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

Ae—Adrian muck, drained. This nearly level, deep, very poorly drained soil is in deep depressions on bottom land, outwash plains, and terraces. It is saturated and is often ponded by runoff from the higher adjacent slopes. Areas are oval or irregular in shape and are 2 to 30 acres in size.

Typically, the surface tier is black muck about 10 inches thick. The subsurface tier is black and very dark brown muck about 11 inches thick. The underlying material to a depth of 60 inches is very dark gray and dark gray, mottled, loamy fine sand and gravelly loamy sand. In many places the surface tier is high in content of mineral material eroded from soils at higher elevations and deposited on top of the muck. In a few areas the muck is less than 16 inches or more than 50 inches thick. In places layers of marl, coprogenous earth, or loamy mineral material are between the muck and the sandy underlying material.

Included with this soil in mapping are undrained areas or areas where the drainage system has failed and marsh vegetation has become established. Also included are small areas of the very poorly drained Granby, Rensselaer, and Sloan soils near the edges of the depressions and along the stream channels on bottom land. These soils are less mucky than the Adrian soil. Included soils make up 8 to 15 percent of the map unit.

The Adrian soil has a high available water capacity. Permeability is moderately slow to moderately rapid in the muck and rapid in the sandy underlying material. The water table is near or above the surface during winter and early spring. Runoff is very slow or ponded. The surface layer is very high in organic matter content. This layer is very friable, and tilth is good.

Drained areas are used for cultivated crops. Some inadequately drained areas are used as pasture. This soil is a probable source of sand and in a few places is a source of gravel.

If drained, this soil is poorly suited to corn, soybeans, and small grain. Wetness and soil blowing are management concerns. Most crops grow poorly in the undrained areas. Maintaining an adequate drainage system is difficult in most areas. Adequate drainage outlets are not available in many areas. Because of the poor stability of the organic material and of the underlying sandy material, ditchbanks tend to cave in. Fine sands can flow into subsurface drains and plug them. Cover crops and a system of conservation tillage that leaves a protective amount of crop residue on the surface help to control soil blowing. Most pesticides are effective only if they are applied at a higher rate than is typical.

This soil is fairly well suited to grasses, such as reed canarygrass, for hay. If drained, it is well suited to pasture. It is poorly suited to deep-rooted legumes, such as alfalfa, because of the ponding and the high water table during wet periods. Because of the poor stability of the muck, haying equipment should be used only during dry periods.

This soil is poorly suited to trees. Seedling mortality, plant competition, the windthrow hazard, and the equipment limitation are management concerns. Replanting of seedlings is often necessary. Water-tolerant species should be selected for planting. Competing vegetation should be controlled by cutting, girdling, or spraying. Carefully thinning the stands or not thinning them at all and applying harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Ordinary crawler tractors and rubber-tired skidders cannot be operated on this soil. Heavy equipment should be used only when the ground is frozen.

Because of the ponding and low strength, this soil is generally unsuitable as a site for dwellings, local roads, and septic tank absorption fields. Extensive changes are needed to make the soil suitable for these uses.

The land capability classification is IVw. The woodland ordination symbol is 2W.

BmA—Blount silt loam, 0 to 2 percent slopes. This nearly level, deep, somewhat poorly drained soil is on slight rises on till plains and moraines. Areas are irregular in shape and are 3 to 25 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 12 inches thick. The subsoil is about 19 inches of brown, olive brown, and light olive brown, mottled, firm silty clay, silty clay loam, and clay loam. The underlying material to a depth of 60 inches is light olive brown, mottled clay loam. In places the soil formed in a mantle of loess or loamy and sandy outwash as much as 36 inches thick. In a few places it is underlain by stratified material. In some areas the slope is more than 2 percent.

Included with this soil in mapping are small areas of the moderately well drained Glynwood and well drained Morley soils on the more sloping parts of the landscape. Also included are the very poorly drained Pewamo soils in depressions. Included soils make up 2 to 10 percent of the map unit.

The Blount soil has a moderate available water capacity. Permeability is slow. The water table is at a depth of 1 to 3 feet during winter and early spring. Runoff is slow. The surface layer has a moderate organic matter content. This layer is friable, and tilth is good.

Most areas of this soil are used for cultivated crops. Some are used for hay or pasture. A few remain wooded, but many of these are being cleared for cultivation.

This soil is well suited to corn, soybeans, and small grain. If drained and otherwise well managed, it can be intensively row cropped. Wetness is the main management concern. Subsurface drains help to remove excess water. A few cobbles and stones on or near the surface can hinder fieldwork. Cover crops and a system of conservation tillage that leaves a protective amount of crop residue on the surface minimize crusting, improve tilth, and increase the rate of water infiltration.

If drained, this soil is well suited to grasses and legumes, such as orchardgrass and ladino clover, for hay or pasture. In undrained areas, however, it is poorly suited to deep-rooted legumes, such as alfalfa, because of the seasonal high water table. Overgrazing or grazing when the soil is too wet results in surface compaction and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is fairly well suited to trees. Seedling mortality and the windthrow hazard are the main management concerns. Some replanting of seedlings may be needed. Carefully thinning the stands and applying harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

Because of the wetness, this soil is severely limited as a site for dwellings. The buildings should be constructed without basements. Subsurface drains lower the water table. The soil is severely limited as a site for local streets and roads because of frost action and low strength. An adequate drainage system along the roads helps to prevent the damage caused by frost action. Strengthening or replacing the base with better suited material improves the ability of the roads and streets to support vehicular traffic.

This soil is severely limited as a site for septic tank absorption fields because of the slow permeability and the wetness. Filling or mounding with suitable material improves the ability of the field to absorb the effluent. Subsurface drains around the outer edges of the absorption field help to remove excess water.

The land capability classification is IIw. The woodland ordination symbol is 3C.

BmB2—Blount silt loam, 1 to 4 percent slopes, eroded. This gently sloping, deep, somewhat poorly drained soil is on till plains and moraines. Areas are irregular in shape and are 3 to 60 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 10 inches thick. It is mixed with dark yellowish brown clay. The subsoil is about 15 inches of dark yellowish brown and yellowish brown, mottled, firm clay and clay loam. The underlying material to a depth of 60 inches is yellowish brown, mottled clay loam. In some places the depth to carbonates is less than 20 inches. In other places the soil formed in a loamy or sandy mantle as much as 30 inches thick. In some areas it is underlain by stratified material. In other areas the slope is more than 4 percent.

Included with this soil in mapping are small areas of severely eroded soils that have a surface layer of clay loam. Also included are the well drained Morley and moderately well drained Glynwood soils on the crest of hills and on the steeper side slopes and the very poorly drained Pewamo soils in depressions. Included soils make up 4 to 12 percent of the map unit.

The Blount soil has a moderate available water capacity. Permeability is slow. The water table is at a depth of 1 to 3 feet during winter and early spring. Runoff is medium. The surface layer has a moderately low organic matter content. This layer is friable, and tilth is fair.

Most areas of this soil are used for cultivated crops. Some are used for hay or pasture. A few remain wooded, but many of these are being cleared for cultivation.

This soil is well suited to corn, soybeans, and small grain. Erosion is the major hazard, and wetness is the major limitation. A few cobbles and stones on or near the surface can hinder fieldwork. A cropping system that includes grasses and legumes, diversions, terraces, contour farming, grassed waterways, and grade stabilization structures help to control erosion and runoff. Cover crops and a system of conservation tillage that leaves a protective amount of crop residue on the surface help to control erosion, minimize crusting, improve tilth, and increase the rate of water infiltration. Subsurface drains help to remove excess water.

If drained, this soil is well suited to grasses and legumes, such as orchardgrass and ladino clover, for hay or pasture. In undrained areas, however, it is poorly suited to deep-rooted legumes, such as alfalfa, because of the seasonal high water table. Overgrazing or grazing when the soil is too wet results in surface compaction, excessive runoff, and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is fairly well suited to trees. Seedling mortality and the windthrow hazard are the main management concerns. Some replanting of seedlings may be needed. Carefully thinning the stands and applying harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

Because of the wetness, this soil is severely limited as a site for dwellings. The buildings should be constructed without basements. Subsurface drains lower the water table. The soil is severely limited as a site for local streets and roads because of frost action and low strength. An adequate drainage system along the roads helps to prevent the damage caused by frost action. Strengthening or replacing the base with better suited material improves the ability of the roads and streets to support vehicular traffic.

This soil is severely limited as a site for septic tank absorption fields because of the slow permeability and the wetness. Filling or mounding with suitable material improves the ability of the field to absorb the effluent. Subsurface drains around the outer edges of the absorption field help to remove excess water.

The land capability classification is IIe. The woodland ordination symbol is 3C.

Bt—Boots muck, undrained. This nearly level, deep, very poorly drained soil is in old glacial lakebeds on moraines. It is ponded or is saturated throughout the year by springs and by runoff from the higher adjacent slopes. Areas are oval or irregular in shape and are 10 to 200 acres in size.

Typically, the upper 15 inches is black muck. Below this to a depth of 60 inches is dark reddish brown, dark brown, and very dark brown, friable peat. In places the soil has a plow layer. In a few areas it is underlain by coprogenous earth, marl, or mineral material within a depth of 60 inches. In some areas the muck is more than 40 inches thick. In other areas the surface layer is silt loam, loam, or sandy loam overwash from the higher adjacent areas.

Included with this soil in mapping are small areas of the very poorly drained Milford and Pewamo soils near the edges of the lakebeds and on slight rises. These soils are less mucky than the Boots soil. They make up 4 to 15 percent of the map unit.

The Boots soil has a very high available water capacity. Permeability is moderate or moderately rapid. The water table is near or above the surface throughout the year. Runoff is very slow or ponded. The surface layer has a very high organic matter content. This layer is very friable.

Most areas support marsh vegetation. Some are partially drained and are used as pasture. This soil is a probable source of peat. Because of the wetness, it is generally unsuited to corn, soybeans, and small grain and to grasses and legumes for hay or pasture. Partially drained areas can be used as pasture. Water-tolerant grasses, such as reed canarygrass, can be grown. Because of low strength, the soil cannot support haying equipment. Because of the wetness, hay does not cure properly.

This soil is poorly suited to trees. Seedling mortality, plant competition, the windthrow hazard, and the equipment limitation are management concerns. Replanting of seedlings is often necessary. Water-tolerant species should be selected for planting. Competing vegetation should be controlled by cutting, girdling, or spraying. Carefully thinning the stands or not thinning them at all and applying harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Ordinary crawler tractors and rubber-tired skidders cannot be operated on this soil. Heavy equipment should be used only when the ground is frozen.

Because of the ponding and low strength, this soil is generally unsuitable as a site for dwellings, local roads, and septic tank absorption fields. Extensive changes are needed to make the soil suitable for these uses.

The land capability classification is Vlw. The woodland ordination symbol is 3W.

BvB—Boyer loamy sand, 2 to 6 percent slopes. This gently sloping, deep, well drained soil is on river terraces, outwash plains, and moraines. Areas are irregular in shape and are 2 to 10 acres in size.

Typically, the surface layer is dark brown loamy sand about 9 inches thick. The subsoil is about 27 inches of dark brown, friable and very friable gravelly sandy clay loam, sandy loam, and gravelly sandy loam. The underlying material to a depth of 60 inches is pale brown, stratified sand and gravelly coarse sand. In places tongues of subsoil material extend into the underlying sand and gravelly coarse sand. They extend below a depth of 40 inches. In some areas the upper part of the subsoil has more clay. In other areas the surface layer is darker. In some places it is sandy loam. In other places the slope is less than 2 or more than 6 percent.

Included with this soil in mapping are small areas of soils that have a gravelly surface layer and a few areas of soils on short, steep slopes. Also included are small areas of the very poorly drained Sebewa soils in narrow depressions and drainageways. Included soils make up 2 to 20 percent of the map unit.

The Boyer soil has a low available water capacity. Permeability is moderately rapid in the solum and very rapid in the underlying material. Runoff is medium. The surface layer has a moderately low organic matter content. This layer is very friable, and tilth is good.

Most areas are used for cultivated crops. Some are used for hay and pasture. A few remain wooded. This soil is a probable source of sand and gravel.

This soil is fairly well suited to corn, soybeans, and small grain. Soil blowing is the main management concern. Droughtiness is a severe hazard during extended dry periods. A few stones on or near the surface can hinder fieldwork. A cropping system that includes grasses and legumes and contour farming help to control soil blowing and runoff. Cover crops and a system of conservation tillage that leaves a protective amount of crop residue on the surface help to control soil blowing, minimize crusting and evaporation, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is well suited to grasses, such as orchardgrass and bromegrass, and legumes, such as alfalfa, for hay and pasture. Drought-tolerant species should be selected for planting. Pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the pasture in good condition.

This soil is well suited to trees. Seedling mortality is the main management concern. Replanting of seedlings is often necessary. Drought-resistant species should be selected for planting.

This soil is well suited to dwellings and to local roads and streets. Because of a poor filtering capacity, it is severely limited as a site for septic tank absorption fields. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. Filling or mounding with suitable material improves the ability of the field to filter the effluent.

The land capability classification is IIIs. The woodland ordination symbol is 4S.

BvC—Boyer loamy sand, 6 to 12 percent slopes. This moderately sloping, deep, well drained soil is on river terraces, outwash plains, and moraines. Areas are irregular in shape and are 2 to 8 acres in size.

Typically, the surface layer is dark brown loamy sand about 10 inches thick. The subsoil is about 24 inches of dark brown, friable and very friable sandy loam and gravelly sandy loam. The underlying material to a depth of 60 inches is pale brown, stratified sand and gravelly coarse sand. In some places the solum is less than 20 inches thick. In other places tongues of subsoil material extend into the underlying sand and gravelly coarse sand. They extend below a depth of 40 inches. In some areas the upper part of the subsoil has more clay. In other areas the surface layer is darker. In a few places it is sandy loam. In places the slope is less than 6 or more than 12 percent.

Included with this soil in mapping are small areas where the slope is more than 18 percent and small areas of severely eroded soils that have a gravelly surface layer. Also included are small areas of the very poorly drained Sebewa soils in narrow depressions and drainageways. Included soils make up 2 to 6 percent of the map unit.

The Boyer soil has a low available water capacity. Permeability is moderately rapid in the upper part of the profile and very rapid in the underlying material. Runoff is medium. The surface layer has a moderately low organic matter content. This layer is very friable, and tilth is good.

Most areas are used for cultivated crops. Some are used for hay and pasture. A few remain wooded. This soil is a probable source of sand and gravel.

This soil is fairly well suited to corn, soybeans, and small grain. Erosion and soil blowing are the main management concerns. Drought is a severe hazard during extended dry periods. A cropping system that includes grasses and legumes, diversions, contour farming, grassed waterways, and grade stabilization structures help to control soil blowing, erosion, and runoff. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control erosion, minimize crusting and evaporation, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is well suited to grasses, such as orchardgrass and bromegrass, and legumes, such as alfalfa, for hay and pasture. Drought-tolerant species should be selected for planting. Pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the pasture in good condition.

This soil is well suited to trees. Seedling mortality is the main management concern. Replanting of seedlings is often necessary. Drought-resistant species should be selected for planting.

Because of the slope, this soil is moderately limited as a site for dwellings and for local roads and streets. Buildings should be designed so that they conform to the natural slope of the land. Disturbing as little of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion. Local roads and streets should be built on the contour. Land shaping may be needed.

Because of a poor filtering capacity, this soil is severely limited as a site for septic tank absorption fields. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. Filling or mounding with suitable material improves the ability of the field to filter the effluent. Installing the absorption field on the contour helps to achieve an even distribution of the effluent.

The land capability classification is IIIe. The woodland ordination symbol is 4S.

BvD—Boyer loamy sand, 12 to 20 percent slopes. This strongly sloping, deep, well drained soil is on river terraces, outwash plains, and moraines. Areas are irregular in shape and are 2 to 8 acres in size.

Typically, the surface layer is dark brown loamy sand about 8 inches thick. The subsoil is dark brown, strong brown, and dark yellowish brown, very friable and friable gravelly sandy loam about 17 inches thick. The underlying material to a depth of 60 inches is pale brown sand and gravelly coarse sand. In some places the solum is less than 20 inches thick. In other places the subsoil has more clay. In some areas the surface layer is darker. In other areas it is sandy loam. In places the slope is less than 12 percent.

Included with this soil in mapping are small areas where the slope is significantly more than 20 percent. Also included are small areas of severely eroded soils that have a gravelly surface layer. Included soils make up 2 to 16 percent of the map unit.

The Boyer soil has a low available water capacity. Permeability is moderately rapid in the solum and very rapid in the underlying material. Runoff is rapid. The surface layer has a moderately low organic matter content. This layer is very friable, and tilth is good.

Most areas are used for cultivated crops. Some are used for hay and pasture. A few remain wooded. This soil is a probable source of sand and gravel.

This soil is poorly suited to corn, soybeans, and small grain. Erosion and soil blowing are the main management concerns. Drought is a severe hazard during extended dry periods. A few stones on or near the surface can hinder fieldwork. A cropping system that includes grasses and legumes, diversions, contour farming, grassed waterways, and grade stabilization structures help to control soil blowing, erosion, and runoff. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control erosion, minimize crusting and evaporation, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is well suited to grasses, such as orchardgrass and bromegrass, and legumes, such as alfalfa, for hay and pasture. Drought-tolerant species should be selected for planting. Pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the pasture in good condition.

This soil is fairly well suited to trees. Seedling mortality, the equipment limitation, and the erosion hazard are the main management concerns. Replanting of seedlings is often necessary. Drought-resistant species should be selected for planting. The slope limits the type of equipment that can be operated safely on this soil. Restricting the use of heavy equipment, constructing logging roads on the contour, and installing water bars help to control erosion.

Because of the slope, this soil is severely limited as a site for dwellings and for local roads and streets. Buildings should be designed so that they conform to the natural slope of the land. Disturbing as little of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion. Local roads and streets should be built on the contour. Land shaping may be needed.

Because of a poor filtering capacity, this soil is severely limited as a site for septic tank absorption fields. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. Filling or mounding with suitable material improves the ability of the field to filter the effluent. Installing the absorption field on the contour helps to achieve an even distribution of the effluent.

The land capability classification is IVe. The woodland ordination symbol is 4R.

BwA—Boyer sandy loam, 0 to 2 percent slopes. This nearly level, deep, well drained soil is on river terraces, outwash plains, and moraines. Areas are elongated and are 3 to 30 acres in size.

Typically, the surface layer is dark brown sandy loam about 9 inches thick. The subsurface layer is about 2 inches of pale brown sandy loam. The subsoil is about 24 inches thick. The upper part is dark brown, firm gravelly sandy clay loam, and the lower part is dark brown and brown, firm and friable gravelly sandy loam and gravelly sandy clay loam. The underlying material to a depth of 60 inches is pale brown gravelly coarse sand. In some places tongues of subsoil material extend into the underlying material. In other places the surface layer is darker. In some areas the upper part of the subsoil has more clay. In other areas the surface layer is loamy fine sand. In places the slope is more than 2 percent.

Included with this soil in mapping are small areas of soils that have a gravelly or stony surface layer and a few areas of soils on short, steep slopes. Also included are small areas of the somewhat poorly drained Homer soils on the lower parts of the landscape and the very poorly drained Sebewa soils in depressions. Included soils make up 5 to 15 percent of the map unit.

The Boyer soil has a low available water capacity. Permeability is moderately rapid in the solum and very rapid in the underlying material. Runoff is slow. The surface layer has a moderately low organic matter content. This layer is friable, and tilth is good.

Most areas are used for cultivated crops. Some are used for hay, pasture, or woodland. This soil is a probable source of sand and gravel.

This soil is fairly well suited to corn, soybeans, and small grain. Soil blowing is the main management concern. Drought is a severe hazard during extended dry periods. A few stones on or near the surface can hinder fieldwork. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control soil blowing, minimize crusting and evaporation, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay or pasture. Drought-tolerant species should be selected for planting. Pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the pasture in good condition.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is suited to dwellings and to local roads and streets. Because of a poor filtering capacity, it is severely limited as a site for septic tank absorption fields. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. Filling or mounding with suitable material improves the ability of the field to filter the effluent.

The land capability classification is IIIs. The woodland ordination symbol is 4A.

BwB—Boyer sandy loam, 2 to 6 percent slopes. This gently sloping, deep, well drained soil is on river terraces, outwash plains, and moraines. Areas are irregular in shape and are 3 to 25 acres in size.

Typically, the surface layer is dark brown sandy loam about 10 inches thick. The subsoil is about 22 inches of dark brown, very friable and friable sandy loam and gravelly sandy loam. The underlying material to a depth of 60 inches is pale brown, stratified sand and gravelly coarse sand. In places tongues of subsoil material extend into the underlying sand and gravelly coarse sand. They extend below a depth of 40 inches. In some areas the solum is less than 20 inches thick. In other areas the surface layer is darker. In some places it is loamy sand. In other places it is moderately eroded. In some areas the upper part of the subsoil has more clay. In other areas the slope is less than 2 or more than 6 percent.

Included with this soil in mapping are small areas of soils that have a gravelly or stony surface layer and a few areas of soils on short, steep slopes. Also included are small areas of the somewhat poorly drained Homer soils on foot slopes and in narrow drainageways. Included soils make up 2 to 15 percent of the map unit.

The Boyer soil has a low available water capacity. Permeability is moderately rapid in the solum and very rapid in the underlying material. Runoff is medium. The surface layer has a moderately low organic matter content. This layer is friable, and tilth is good.

Most areas are used for cultivated crops. Some are used for hay or pasture. A few remain wooded. This soil is a probable source of sand and gravel.

This soil is fairly well suited to corn, soybeans, and small grain. Drought is a severe hazard during extended dry periods. Erosion and soil blowing are management concerns. A few stones on or near the surface can hinder fieldwork. A cropping system that includes grasses and legumes, diversions, contour farming, grassed waterways, and grade stabilization structures help to control erosion and runoff. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control erosion, minimize crusting and evaporation, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay or pasture. Drought-tolerant species should be selected for planting. Pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the pasture in good condition.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is suitable as a site for dwellings and for local roads and streets. Because of a poor filtering capacity, it is severely limited as a site for septic tank absorption fields. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. Filling or mounding with suitable material improves the ability of the field to filter the effluent.

The land capability classification is IIIs. The woodland ordination symbol is 4A.

BwC—Boyer sandy loam, 6 to 12 percent slopes. This moderately sloping, deep, well drained soil is on river terraces, outwash plains, and moraines. Areas are irregular in shape and are 3 to 8 acres in size.

Typically, the surface layer is dark brown sandy loam about 9 inches thick. The subsoil is about 19 inches thick. The upper part is dark yellowish brown, firm gravelly sandy clay loam, and the lower part is dark brown, friable gravelly sandy loam. The underlying material to a depth of 60 inches is pale brown sand and gravelly coarse sand. In some places the solum is less than 20 inches thick. In other places tongues of subsoil material extend into the underlying sand and gravelly coarse sand. They extend below a depth of 40 inches. In some areas the surface layer is darker. In a few areas it is loamy fine sand. In some places it is moderately eroded. In other places the upper part of the subsoil has more clay. In some areas the slope is less than 6 or more than 12 percent.

Included with this soil in mapping are small areas where the slope is more than 18 percent and small areas of severely eroded soils that have a gravelly or stony surface layer. Also included are small areas of the somewhat poorly drained Homer soils in narrow drainageways. Included soils make up 2 to 10 percent of the map unit.

The Boyer soil has a low available water capacity. Permeability is moderately rapid in the solum and very rapid in the underlying material. Runoff is medium. The surface layer has a moderately low organic matter content. This layer is friable, and tilth is good.

Most areas are used for cultivated crops. Some are used for hay or pasture. A few remain wooded. This soil is a probable source of sand and gravel.

This soil is fairly well suited to corn, soybeans, and small grain. Erosion and soil blowing are the main management concerns. Drought is a severe hazard during extended dry periods. A few stones on or near the surface can hinder fieldwork. A cropping system that includes grasses and legumes, diversions, contour farming, grassed waterways, and grade stabilization structures help to control erosion and runoff. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control erosion and soil blowing, minimize crusting and evaporation, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay or pasture. Drought-tolerant species should be selected for planting. Pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the pasture in good condition.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting.

Because of the slope, this soil is moderately limited as a site for dwellings and for local roads and streets. Buildings should be designed so that they conform to the natural slope of the land. Disturbing as little of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion. Local roads and streets should be built on the contour. Land shaping may be needed.

Because of a poor filtering capacity, this soil is severely limited as a site for septic tank absorption fields. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. Filling or mounding with suitable material improves the ability of the field to filter the effluent. Installing the absorption field on the contour helps to achieve an even distribution of the effluent.

The land capability classification is IIIe. The woodland ordination symbol is 4A.

ByC3—Boyer loam, 6 to 15 percent slopes, severely eroded. This moderately sloping, deep, well drained soil is on river terraces, outwash plains, and moraines. A few shallow gullies and rills have formed during periods of heavy rainfall. Areas are irregular in shape and are 2 to 10 acres in size.

Typically, the surface layer is brown loam about 8 inches thick. In most areas, nearly all of the original darkened surface layer has been removed by erosion and tillage has mixed the rest with the upper part of the subsoil. The subsoil is about 17 inches of brown and dark brown, firm and friable gravelly sandy clay loam and gravelly sandy loam. The underlying material to a depth of 60 inches is pale brown gravelly coarse sand. In some places, the surface layer is moderately eroded and surface soil is deposited on foot slopes. In other places the solum is less than 20 inches thick. In a few places tongues of subsoil material extend into the underlying gravelly coarse sand. They extend below a depth of 40 inches. In some areas the upper part of the subsoil has more clay. In other areas, the soil is very severely eroded and the underlying sand and gravel are exposed. In places the slope is less than 6 or more than 12 percent.

Included with this soil in mapping are small areas of soils on short, steep slopes. Also included are small areas of the somewhat poorly drained Homer soils in narrow drainageways. Included soils make up 2 to 10 percent of the map unit.

The Boyer soil has a low available water capacity. Permeability is moderately rapid in the solum and very rapid in the underlying material. Runoff is rapid. The surface layer has a low organic matter content. This layer is firm, and tilth is fair.

Most areas are used for cultivated crops. A few are used for hay or pasture. This soil is a probable source of sand and gravel.

This soil is poorly suited to corn, soybeans, and small grain. Erosion is the main management concern. Drought is a severe hazard during extended dry periods. A few stones on or near the surface can hinder fieldwork. A cropping system that includes grasses and legumes, diversions, terraces, contour farming, grassed waterways, and grade stabilization structures help to control erosion and runoff. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface minimize crusting and evaporation, improve tilth, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is fairly well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay. It is well suited to pasture. Drought-tolerant species should be selected for planting. Pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the pasture in good condition.

This soil is well suited to trees. No major hazards or limitations affect planting or harvesting.

Because of the slope, this soil is moderately limited as a site for dwellings and for local roads and streets. Buildings should be designed so that they conform to the natural slope of the land. Disturbing as little of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion. Local roads and streets should be built on the contour. Land shaping may be needed.

Because of a poor filtering capacity, this soil is severely limited as a site for septic tank absorption fields. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. Filling or mounding with suitable material improves the ability of the field to filter the effluent. Installing the absorption field on the contour helps to achieve an even distribution of the effluent.

The land capability classification is IVe. The woodland ordination symbol is 4A.

Bz—Brookston loam. This nearly level, deep, very poorly drained soil is in depressions and narrow drainageways on moraines. It is ponded by runoff from the higher adjacent slopes. Areas are irregular in shape and are 3 to 20 acres in size.

Typically, the surface layer is very dark grayish brown loam about 9 inches thick. The subsurface layer is about 8 inches of very dark gray loam. The subsoil is dark gray, grayish brown, gray, and dark grayish brown, mottled, firm clay loam about 36 inches thick. The underlying material to a depth of 60 inches is brown, mottled loam. In a few areas the dark surface soil is less than 10 inches thick. In some places stratified loamy or sandy material is directly above the underlying glacial till. In other places the upper part of the solum formed in as much as 30 inches of lacustrine material. In a few places the subsoil or underlying material has more clay. In some areas the surface layer is lighter colored.

Included with this soil in mapping are undrained areas in woodlots and deep depressions that are wet most of the year. Also included are small areas of the somewhat poorly drained Crosier soils on slight rises and the well drained Miami, Riddles, and Wawasee soils on the higher, more sloping parts of the landscape. Included soils make up 5 to 15 percent of the map unit.

The Brookston soil has a high available water capacity. Permeability is moderate. The water table is near or above the surface during winter and early spring. Runoff is very slow or ponded. The surface layer has a high organic matter content. This layer is friable, and tilth is good.

Most areas of this soil are used for cultivated crops. Some are used for hay or pasture. A few remain wooded, but many of these are being cleared and drained for cultivation.

If drained, this soil is well suited to corn, soybeans, and small grain. If drained and otherwise well managed, it can be intensively row cropped. Wetness and ponding are management concerns. Shallow surface drains and subsurface drains can remove excess water if adequate outlets are available. In some areas preparing a seedbed is difficult. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface minimize crusting, improve tilth, and increase the rate of water infiltration. The soil is well suited to fall plowing.

If drained, this soil is well suited to grasses, such as bromegrass, and legumes, such as ladino clover, for hay or pasture. Deep-rooted legumes, such as alfalfa, grow poorly in undrained areas. Even if subsurface drains are installed, the legumes can be damaged during brief periods of ponding. Overgrazing or grazing when the soil is wet results in surface compaction and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Seedling mortality, the windthrow hazard, the equipment limitation, and plant competition are management concerns. Replanting of seedlings is often necessary. Water-tolerant species should be selected for planting. Competing vegetation can be controlled by cutting, girdling, or spraying. Carefully thinning the stands or not thinning them at all and applying harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Harvesting activities are restricted to dry periods or to periods when the ground is frozen.

Because of the ponding, this soil is generally unsuitable as a site for dwellings and sanitary facilities. It is severely limited as a site for local roads because of frost action, low strength, and ponding. Constructing the roads on raised, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by ponding and frost action. Strengthening or replacing the base with better suited material improves the ability of the roads to support vehicular traffic.

The land capability classification is IIw. The woodland ordination symbol is 5W.

Co—Coesse silty clay loam. This nearly level, deep, very poorly drained soil is in deep depressions on till plains and moraines. It is ponded by runoff from the higher adjacent slopes. Areas are oval or irregular in shape and are 3 to 15 acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 8 inches thick. The next 14 inches is dark grayish brown, mottled, firm silty clay loam. Below this is a buried surface layer of very dark gray silty clay about 12 inches thick. The buried subsoil is about 36 inches of dark grayish brown, grayish brown, and olive brown, mottled, very firm silty clay and clay loam. The underlying material to a depth of 80 inches is olive brown, mottled clay loam. In some places the depth to the buried soil is less than 20 inches. In other places the underlying material is glacial till or loamy glacial outwash. In some areas the buried soil has less clay. In a few areas the soil is underlain by muck.

Included with this soil in mapping are undrained areas that stay wet most of the year. Also included are small areas of somewhat poorly drained soils on the edges of the depressions and on slight rises and small areas of mucky soils in the lowest part of the depressions. Included soils make up 5 to 15 percent of the map unit.

The Coesse soil has a high available water capacity. Permeability is moderately slow. The water table is near or above the surface during winter and early spring. Runoff is very slow or ponded. The surface layer has a moderate organic matter content. This layer is friable, and tilth is fair.

Most areas of this soil are used for cultivated crops. A few are used for hay or pasture. Some are used as woodland or wildlife habitat.

If drained, this soil is well suited to corn, soybeans, and small grain. If drained and otherwise well managed, it can be intensively row cropped. Most crops grow poorly in undrained areas. Wetness and ponding are management concerns. Surface drains and subsurface drains can remove excess water, but in some areas adequate drainage outlets are not available. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface minimize crusting, improve tilth, and increase the rate of water infiltration. The soil is well suited to fall plowing.

If drained, this soil is well suited to grasses, such as bromegrass, for hay or pasture. In undrained areas it is well suited to reed canarygrass but is poorly suited to deep-rooted legumes, such as alfalfa. Even if subsurface drains are installed, the legumes can be damaged during brief periods of ponding. Overgrazing or grazing when the soil is wet results in surface compaction and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Seedling mortality, plant competition, the windthrow hazard, and the equipment limitation are management concerns. Replanting of seedlings is often necessary. Water-tolerant species should be selected for planting. Competing vegetation can be controlled by cutting, girdling, or spraying. Carefully thinning the stands or not thinning them at all and applying harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Harvesting activities are restricted to dry periods or to periods when the ground is frozen.

Because of the ponding, this soil is generally unsuitable as a site for dwellings and sanitary facilities. It is severely limited as a site for local roads because of low strength, ponding, and frost action. Constructing the roads on raised, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by ponding and frost action and improve the traffic-supporting capacity.

The land capability classification is IIw. The woodland ordination symbol is 5W.

CsA—Crosier sandy loam, 0 to 3 percent slopes. This nearly level, deep, somewhat poorly drained soil is on moraines. Areas are irregular in shape and are 2 to 20 acres in size.

Typically, the surface layer is dark grayish brown sandy loam about 8 inches thick. The subsoil is about 17 inches of light brownish gray, light olive brown, and olive brown, mottled, friable and firm loam and clay loam. The underlying material to a depth of 60 inches is light olive brown, mottled sandy loam. In a few places stratified sandy material is directly above the underlying glacial till. In a few areas the underlying material has more clay. In places the solum is more than 40 inches thick.

Included with this soil in mapping are small areas of the well drained Miami, Riddles, and Wawasee soils on the more sloping parts of the landscape and the very poorly drained Brookston soil in the small depressions and drainageways. Included soils make up 7 to 15 percent of the map unit.

The Crosier soil has a high available water capacity. Permeability is moderately slow. The water table is at a depth of 1 to 3 feet during winter and early spring. Runoff is slow. The surface layer has a moderate organic matter content. This layer is friable, and tilth is good.

Most areas of this soil are used for cultivated crops. Some are used for hay and pasture. A few remain wooded, but many of these are being cleared for cultivation.

This soil is well suited to corn, soybeans, and small grain. If drained and otherwise properly managed, it can be intensively row cropped. Wetness and soil blowing are the main management concerns. Subsurface drains help to remove excess water. A few cobbles and stones on or near the surface can hinder fieldwork. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface minimize crusting and soil blowing, improve tilth, and increase the rate of water infiltration.

If drained, this soil is well suited to grasses, such as orchardgrass, and legumes, such as ladino clover and birdsfoot trefoil, for hay and pasture. Deep-rooted legumes, such as alfalfa, grow poorly in undrained areas because of the seasonal high water table. Overgrazing or grazing when the soil is wet results in surface compaction and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying.

Because of the wetness, this soil is severely limited as a site for dwellings. The buildings should be constructed without basements. Subsurface drains lower the water table. The soil is severely limited as a site for local roads and streets because of low strength and frost action. An adequate drainage system along the roads helps to prevent the damage caused by frost action. Replacing or strengthening the base with better suited material improves the ability of the roads and streets to support vehicular traffic.

This soil is severely limited as a site for septic tank absorption fields because of the wetness and the moderately slow permeability. Enlarging the absorption field helps to compensate for the restricted permeability. Installing interceptor drains around the absorption field lowers the water table.

The land capability classification is IIw. The woodland ordination symbol is 4A.

Fu—Fulton silty clay loam. This nearly level, deep, somewhat poorly drained soil is on till plains and moraines. Areas are irregular in shape and are 3 to 25 acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 10 inches thick. The subsoil is about 22 inches of dark brown and brown, mottled, firm clay and silty clay. The underlying material to a depth of 60 inches is brown, mottled, stratified silty clay, silty clay loam, silt loam, and loamy fine sand. In some places the soil formed in a mantle of loamy or sandy outwash as much as 36 inches thick. In other places it is underlain by glacial till within a depth of 60 inches. In some areas the slope is more than 3 percent.

Included with this soil in mapping are small areas of the moderately well drained Glynwood soils on rises and the very poorly drained Milford soils in depressions. Included soils make up 2 to 10 percent of the map unit.

The Fulton soil has a moderate available water capacity. Permeability is slow. The water table is at a depth of 1.0 to 2.5 feet during winter and early spring. Runoff is slow. The surface layer has a moderate organic matter content. This layer is friable, and tilth is good.

Most areas of this soil are used for cultivated crops. Some are used for hay or pasture. A few remain wooded, but many of these are being cleared for cultivation.

This soil is fairly well suited to corn, soybeans, and small grain. If drained and otherwise well managed, it can be intensively row cropped. Wetness is the main management concern. Subsurface drains help to remove excess water. If these drains are installed below a depth of 30 inches, fine sand can flow into the drains and clog them. Cover crops and a system of conservation tillage that leaves a protective amount of crop residue on the surface minimize crusting, improve tilth, and increase the rate of water infiltration.

If drained, this soil is well suited to grasses, such as orchardgrass, and legumes, such as ladino clover and birdsfoot trefoil, for hay or pasture. In undrained areas it is poorly suited to deep-rooted legumes, such as alfalfa, because of the seasonal high water table. Overgrazing or grazing when the soil is too wet results in surface compaction and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to trees. The equipment limitation, seedling mortality, and the windthrow hazard are the main management concerns. Equipment should be used only during dry periods or when the ground is frozen. Some replanting of seedlings may be needed. Carefully thinning the stands or not thinning them at all and applying harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

Because of the wetness and the shrink-swell potential, this soil is severely limited as a site for dwellings. The buildings should be constructed without basements. Subsurface drains lower the water table. Strengthening foundations and footings and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. The soil is severely limited as a site for local roads and streets because of the shrink-swell potential and low strength. Installing an adequate drainage system and strengthening or replacing the base with better suited material improve the ability of the roads and streets to support vehicular traffic and help to prevent the damage caused by shrinking and swelling.

This soil is severely limited as a site for septic tank absorption fields because of the slow permeability and the wetness. Filling or mounding with suitable material improves the ability of the field to absorb the effluent. Subsurface drains around the outer edges of the absorption field help to remove excess water.

The land capability classification is IIIw. The woodland ordination symbol is 4C.

GsB2—Glynwood loam, 3 to 6 percent slopes, eroded. This gently sloping, deep, moderately well drained soil is on till plains and moraines. Areas are irregular in shape and are 3 to 45 acres in size.

Typically, the surface layer is about 8 inches of dark grayish brown loam. It is mixed with dark yellowish brown clay loam. The subsoil is dark yellowish brown, mottled, firm clay about 14 inches thick. The underlying material to a depth of 60 inches is brown, mottled clay loam. In some places the depth to the underlying material is less than 16 inches. In other places the soil formed in loamy or sandy material as much as 30 inches thick. In a few areas the upper part of the subsoil is not mottled. In some areas the slope is more than 6 percent.

Included with this soil in mapping are small areas of severely eroded soils that have a surface layer of clay loam. Also included are a few small pockets of sand and gravel, some breaks that have a slope of more than 12 percent, small areas of the somewhat poorly drained Blount and Fulton soils on foot slopes and along narrow drainageways, and small areas of the very poorly drained Pewamo soils in the depressions and drainageways. Included soils make up 5 to 15 percent of the map unit.

The Glynwood soil has a moderate available water capacity. Permeability is slow. The water table is at a depth of 2.0 to 3.5 feet during winter and early spring. Runoff is medium. The surface layer has a moderately low organic matter content. This layer is friable, and tilth is fair.

Most areas of this soil are used for cultivated crops. Some are used for hay or pasture. A few remain wooded, but many of these are being cleared for cultivation.

This soil is well suited to corn, soybeans, and small grain. The hazard of erosion is the main management concern. A few cobbles and stones on or near the surface can hinder fieldwork. A cropping system that includes grasses and legumes, diversions, grassed waterways (fig. 5), and grade stabilization structures help to control erosion and runoff. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control erosion, minimize crusting, improve tilth, and increase the rate of water infiltration.

This soil is well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay or pasture. Overgrazing or grazing when the soil is wet results in surface compaction, excessive runoff, and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to trees. Seedling mortality, the windthrow hazard, and plant competition are the main management concerns. Some replanting of seedlings may be needed. Carefully thinning the stands reduces the windthrow hazard. Competing vegetation can be controlled by cutting, girdling, or spraying.

Because of the wetness and the shrink-swell potential, this soil is moderately limited as a site for dwellings without basements. It is severely limited as a site for dwellings with basements because of the wetness. Subsurface drains help to lower the water table. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. Disturbing as little of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion.

Because of low strength and frost action, this soil is severely limited as a site for local roads and streets. An adequate drainage system along the roads helps to prevent the damage caused by frost action. Replacing or strengthening the base with better suited material improves the ability of the roads and streets to support vehicular traffic.

Because of the wetness and the slow permeability, this soil is severely limited as a site for septic tank absorption fields. Filling or mounding with suitable material improves the ability of the field to absorb the effluent. Subsurface drains around the outer edges of the absorption field help to remove excess water.

The land capability classification is IIe. The woodland ordination symbol is 4C.

GtB3—Glynwood clay loam, 3 to 8 percent slopes, severely eroded. This gently sloping and moderately sloping, deep, moderately well drained soil is on till

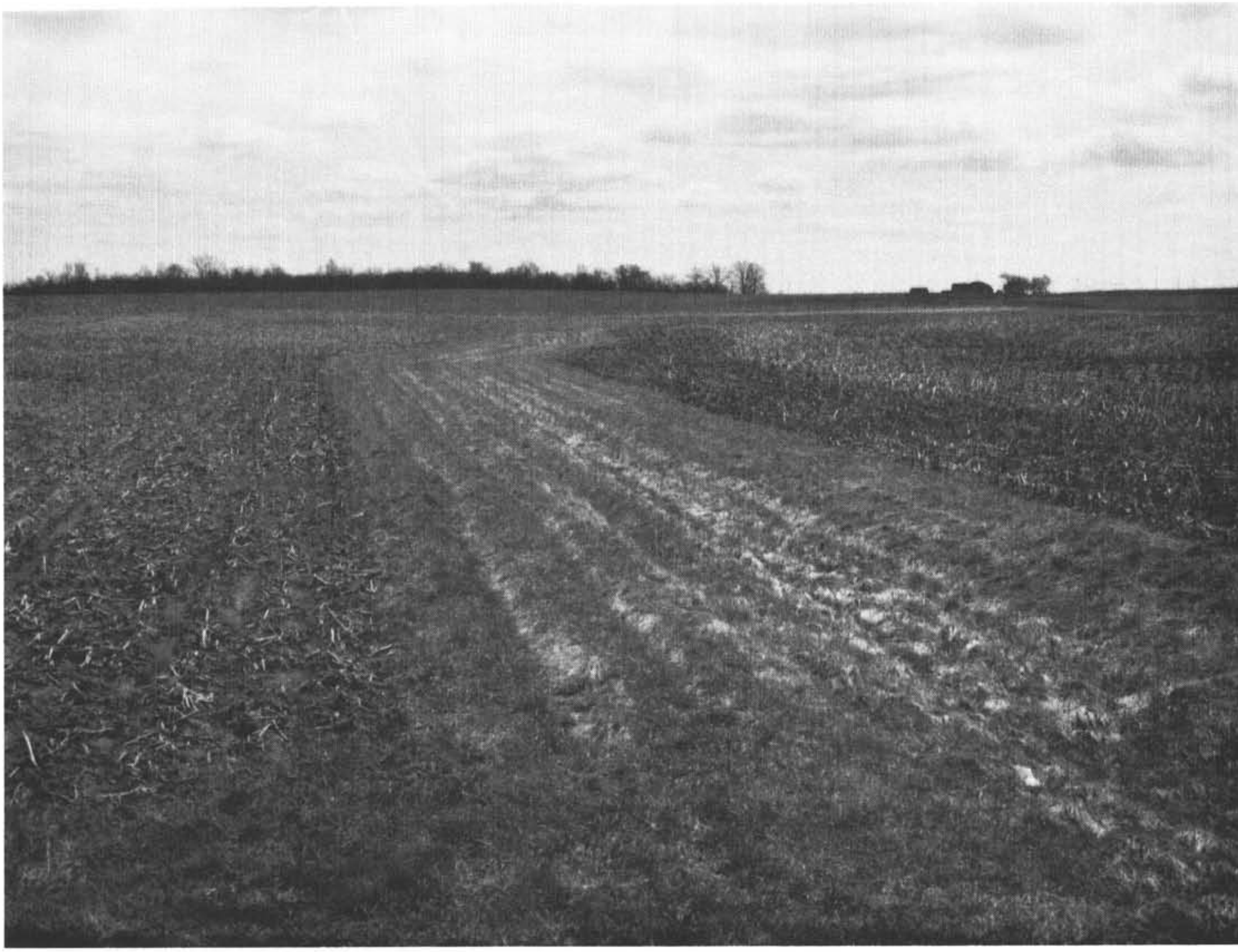

Figure 5.—A grassed waterway in an area of Glynwood loam, 3 to 6 percent slopes, eroded.

plains and moraines. Areas are irregular in shape and are 3 to 25 acres in size.

Typically, the surface layer is dark yellowish brown clay loam about 9 inches thick. In most areas, nearly all of the original darkened surface layer has been removed by erosion and tillage has mixed the rest with the upper part of the subsoil. The subsoil is about 12 inches of dark yellowish brown, mottled, firm clay and clay loam. The underlying material to a depth of 60 inches is yellowish brown, mottled clay loam. In some places the soil is slightly or moderately eroded. In other places it is very severely eroded. In some areas the slope is more than 8 percent.

Included with this soil in mapping are small areas of the somewhat poorly drained Blount and Fulton soils on foot slopes and the very poorly drained Pewamo soils along narrow drainageways. Included soils make up 5 to 10 percent of the map unit.

The Glynwood soil has a moderate available water capacity. Permeability is slow. The water table is at a depth of 2.0 to 3.5 feet during winter and early spring. Runoff is rapid. The surface layer has a low organic matter content. This layer is firm, and tilth is poor.

Most areas of this soil are used for cultivated crops. Some are used for hay or pasture. A few are planted to trees.

This soil is fairly well suited to corn, soybeans, and small grain. The erosion hazard is the main management concern. Plowing and preparing a suitable seedbed are difficult. The soil remains wet for long periods and becomes cloddy as it dries. A few cobbles and stones on or near the surface can hinder fieldwork. A cropping system that includes grasses and legumes, diversions, grassed waterways, and grade stabilization structures help to control erosion and runoff. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control erosion, minimize crusting, improve tilth, and increase the rate of water infiltration.

This soil is well suited to grasses, such as orchardgrass, and legumes, such as red clover and alfalfa, for hay or pasture. Overgrazing or grazing when the soil is wet results in surface compaction, excessive runoff, and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to trees. Seedling mortality, the windthrow hazard, and plant competition are the main management concerns. Some replanting of seedlings may be needed. Carefully thinning the stands reduces the windthrow hazard. Competing vegetation can be controlled by cutting, girdling, or spraying.

Because of the wetness and the shrink-swell potential, this soil is moderately limited as a site for dwellings without basements. It is severely limited as a site for dwellings with basements because of the wetness. Subsurface drains help to lower the water table. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. Disturbing as little of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion.

Because of low strength and frost action, this soil is severely limited as a site for local roads and streets. An adequate drainage system along the roads helps to prevent the damage caused by frost action. Replacing or strengthening the base with better suited material improves the ability of the roads and streets to support vehicular traffic.

Because of the wetness and the slow permeability, this soil is severely limited as a site for septic tank absorption fields. Filling or mounding with suitable material improves the ability of the field to absorb the effluent. Subsurface drains around the outer edges of the absorption field help to remove excess water.

The land capability classification is IIIe. The woodland ordination symbol is 4C.

Gw—Granby loamy sand. This nearly level, deep, very poorly drained soil is in depressions on outwash plains. It is ponded by runoff from the higher adjacent slopes. Areas are irregular in shape and are 3 to 15 acres in size.

Typically, the surface layer is black loamy sand about 11 inches thick. The subsoil is about 21 inches of light gray and light brownish gray, very friable and loose loamy sand and sand. The underlying material to a depth of 60 inches is light gray and pale brown gravelly sand and sand. In a few areas the surface layer is mucky loamy sand or mucky sand. In some places the dark surface layer is less than 10 inches thick. In other places the subsoil has more clay. In some areas glacial till is within a depth of 60 inches. In other areas the surface layer is lighter colored.

Included with this soil in mapping are small undrained areas in woodlots and deep depressions. These areas stay wet most of the year. Also included are small areas of the very poorly drained Adrian and Houghton soils in the lowest part of the depressions and the very poorly drained Mermill soils on the edges of the depressions and on slight rises. Adrian and Houghton soils are mucky. Mermill soils are more clayey than the Granby soil. Included soils make up 2 to 10 percent of the map unit.

The Granby soil has a low available water capacity. Permeability is rapid. The water table is near or above the surface during winter and early spring. Runoff is very slow or ponded. The surface layer has a high organic matter content. This layer is very friable, and tilth is good.

Most areas are used for cultivated crops. Some are used for hay or pasture. A few remain wooded, but many of these are being cleared and drained for cultivation. This soil is a probable source of sand.

If drained, this soil is poorly suited to corn, soybeans, and small grain. Wetness, ponding, and soil blowing are the major management concerns. Shallow surface drains and subsurface drains can remove excess water if adequate outlets are available. The sandy material can clog the subsurface drains. If the soil is excessively drained, drought is a hazard. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control soil blowing.

If drained, this soil is fairly well suited to grasses, such as bromegrass, and legumes, such as ladino clover, for hay and is well suited to pasture. In undrained areas it is well suited to reed canarygrass. Deep-rooted legumes, such as alfalfa, grow poorly in inadequately drained areas. Even if subsurface drains are installed, the legumes can be damaged during brief periods of ponding. Overgrazing or grazing when the soil is too wet results in surface compaction and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is fairly well suited to trees. Seedling mortality, the windthrow hazard, the equipment limitation, and plant competition are management concerns. Replanting of seedlings is often needed. Water-tolerant species should be selected for planting. Competing vegetation can be controlled by cutting, girdling, or spraying. Carefully thinning the stands or not thinning them at all and applying harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Harvesting activities are restricted to dry periods or to periods when the ground is frozen.

Because of the ponding, this soil is generally unsuitable as a site for dwellings and sanitary facilities and is severely limited as a site for local roads. Constructing the roads on raised, well compacted fill material and providing adequate ditches and culverts help to prevent the road damage caused by ponding.

The land capability classification is IVw. The woodland ordination symbol is 4W.

HbA—Haskins loam, 0 to 3 percent slopes. This nearly level, deep, somewhat poorly drained soil is on till plains and moraines. Areas are irregular in shape and are 3 to 30 acres in size.

Typically, the surface layer is dark grayish brown loam about 11 inches thick. The subsoil is mottled, firm clay loam about 26 inches thick. The upper part is grayish brown and yellowish brown, and the lower part is dark brown and brown. The underlying material to a depth of 60 inches is brown, mottled silty clay loam. In some places it has less clay. In other places the upper part of the solum has less clay and is sandy. In a few areas the surface layer is gravelly. In some areas the loamy material is less than 20 inches thick. In other areas the soil is underlain by stratified silty clay loam to sand. In places the slope is more than 3 percent.

Included with this soil in mapping are small areas of the moderately well drained Rawson soils on the more sloping parts of the landscape and the very poorly drained Mermill and Pewamo soils in depressions. Included soils make up 10 to 15 percent of the map unit.

The Haskins soil has a moderate available water capacity. Permeability is moderate in the upper part of the profile and slow in the lower part. The water table is at a depth of 1.0 to 2.5 feet during winter and early spring. Runoff is slow. The surface layer has a moderate organic matter content. This layer is friable, and tilth is good.

Most areas of this soil are used for cultivated crops. Some are used for hay or pasture. A few remain wooded, but many of these are being cleared and drained for cultivation.

This soil is well suited to corn, soybeans, and small grain. If drained and properly managed, it can be intensively row cropped. Wetness is the main management concern. Subsurface drains help to remove excess water. Cover crops and a system of conservation tillage that leaves a protective amount of crop residue on the surface minimize crusting, improve tilth, and increase the rate of water infiltration.

If drained, the soil is well suited to grasses, such as orchardgrass, and legumes, such as ladino clover and birdsfoot trefoil, for hay or pasture. Deep-rooted legumes, such as alfalfa, grow poorly in undrained areas because of the seasonal high water table. Overgrazing or grazing when the soil is wet results in surface compaction and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying.

Because of the wetness, this soil is severely limited as a site for dwellings. The buildings should be constructed without basements. Subsurface drains help to lower the water table. Because of frost action, the soil is severely limited as a site for local roads and streets. An adequate drainage system along the roads helps to prevent the damage caused by frost action. Replacing or strengthening the base with better suited material improves the ability of the roads and streets to support vehicular traffic.

Because of the wetness and the slow permeability, this soil is severely limited as a site for septic tank absorption fields. Installing subsurface drains around the absorption field lowers the water table. Enlarging the absorption field and controlling the rate of flow from a holding tank improve the ability of the field to absorb the effluent.

The land capability classification is IIw. The woodland ordination symbol is 4A.

HeG—Hennepin loam, 25 to 50 percent slopes. This steep, deep, well drained soil is on sharp breaks and along the sides of deeply incised drainageways (fig. 6). Areas are long and narrow and are 2 to 5 acres in size.

Typically, the surface layer is very dark grayish brown loam about 3 inches thick. The subsoil is dark yellowish brown and brown, firm clay loam about 15 inches thick. The underlying material to a depth of 60 inches is yellowish brown clay loam. In many places the subsoil is thin and has a higher content of clay. In some areas the soil has strata of silty and loamy material. In other areas the slope is less than 25 or more than 50 percent.

Included with this soil in mapping are small areas of severely eroded soils and areas of soils that have strata of sand and gravel. Also included are small areas of the well drained Miami and Morley soils and the somewhat poorly drained Shoals soils. Miami and Morley soils are on ridgetops, and Shoals soils are on narrow bottom land. Included soils make up 10 to 15 percent of the map unit.

The Hennepin soil has a moderate available water capacity. Permeability is slow. Runoff is very rapid. The surface layer has a moderately low organic matter content. It is friable.

Most areas remain wooded. Some are used as pasture. This soil is generally unsuited to cultivated crops and to hay and is poorly suited to grasses and legumes for pasture. Erosion is a severe hazard. The slope limits the types of equipment that can be operated safely on

Figure 6.—An area of Hennepin loam, 25 to 50 percent slopes.

this soil. Overgrazing or grazing when the soil is too wet results in surface compaction, excessive runoff, and erosion. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in the best condition possible.

This soil is poorly suited to trees. Plant competition, the erosion hazard, and the equipment limitation are management concerns. Unwanted trees and shrubs can be removed by cutting, girdling, or spraying. The types of equipment that can be operated safely on these slopes are limited. Restricting the use of heavy equipment, constructing logging roads on the contour, and installing water bars help to control erosion.

Because of the slope, this soil is generally unsuitable as a site for dwellings and sanitary facilities and is severely limited as a site for local roads and streets. Cutting and filling are needed on sites for roads. Also, the roads should be built on the contour where possible. Providing adequate ditches and culverts helps to control erosion. Areas disturbed during construction should be revegetated as soon as possible.

The land capability classification is VIIe. The woodland ordination symbol is 5R.

Ho—Homer loam. This nearly level, somewhat poorly drained soil is on terraces and outwash plains. It is moderately deep over gravelly loamy coarse sand, sand,

and gravelly coarse sand. Areas are irregular in shape and are 3 to 20 acres in size.

Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsoil is about 28 inches thick. The upper part is dark grayish brown, friable sandy clay loam. The lower part is strong brown, yellowish brown, and dark grayish brown, mottled, very friable to firm gravelly sandy clay loam. The underlying material to a depth of 60 inches is dark grayish brown and gray gravelly loamy coarse sand, gravelly coarse sand, and sand. In some places the subsoil extends below a depth of 40 inches. In other places the soil has less gravel. In some areas the surface layer is gravelly. In other areas the soil is underlain by glacial till within a depth of 6 feet.

Included with this soil in mapping are small areas of the well drained Boyer and Kalamazoo soils on rises and the very poorly drained Sebewa soils in narrow drainageways and depressions. Included soils make up 2 to 15 percent of the map unit.

The Homer soil has a moderate available water capacity. Permeability is moderate in the solum and very rapid in the underlying material. The water table is at a depth of 1 to 3 feet during winter and early spring. Runoff is slow. The surface layer has a moderate organic matter content. This layer is friable, and tilth is good.

Most areas are used for cultivated crops. Some are used for hay or pasture. A few remain wooded, but many of these are being cleared for cultivation. This soil is a probable source of sand and gravel.

This soil is well suited to corn, soybeans, and small grain. If drained and properly managed, it can be intensively row cropped. Wetness is the main management concern. Subsurface drains help to remove excess water. In some areas the soil has thin layers of fine sand, which can clog the drains. If the soil is excessively drained, drought is a hazard during extended dry periods. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface reduce the evaporation rate, minimize crusting, improve tilth, and increase the rate of water infiltration.

This soil is well suited to grasses, such as orchardgrass, and legumes, such as ladino clover and birdsfoot trefoil, for hay or pasture. Deep-rooted legumes, such as alfalfa, grow poorly in undrained areas because they cannot withstand the seasonal high water table. Overgrazing or grazing when the soil is wet results in surface compaction and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is fairly well suited to trees. Plant competition is moderate. Unwanted trees and shrubs can be removed by cutting, girdling, or spraying.

Because of the wetness, this soil is severely limited as a site for dwellings. The buildings should be constructed without basements. Subsurface drains help to lower the water table. Because of low strength and frost action, the soil is severely limited as a site for local roads and streets. An adequate drainage system along the roads reduces the potential for frost action. Replacing or strengthening the base with better suited material improves the ability of the roads and streets to support vehicular traffic.

Because of the wetness and a poor filtering capacity, this soil is severely limited as a site for septic tank absorption fields. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. Filling or mounding with suitable material improves the ability of the field to filter the effluent. Subsurface drains around the outer edges of the absorption field lower the water table.

The land capability classification is IIw. The woodland ordination symbol is 4A.

Hs—Houghton muck, undrained. This nearly level, deep, very poorly drained soil is in deep depressions on moraines and outwash plains. It is ponded or saturated throughout the year by springs and by runoff from the higher adjacent slopes. Areas are oval or irregular in shape and are 2 to 65 acres in size.

Typically, the surface tier is black muck about 6 inches thick. Below this to a depth of 60 inches is black and dark reddish brown, friable muck. In some places the soil has a plow layer. In other places coprogenous earth, marl, or sandy and loamy material is within a depth of 50 inches. In some areas the surface tier has a high content of mineral material. In other areas the subsurface and bottom tiers have a higher content of fibers.

Included with this soil in mapping are small areas of the very poorly drained Granby, Mermill, Milford, Pewamo, Rensselaer, and Saranac soils near the edge of the depressions and on slight rises. These soils are less mucky than the Houghton soil. They make up 8 to 15 percent of the map unit.

The Houghton soil has a very high available water capacity. Permeability is moderately slow to moderately rapid. The water table is near or above the surface throughout the year. Runoff is very slow or ponded. The surface layer has a very high organic matter content. This layer is very friable.

Most areas support marsh vegetation. Some are partially drained and are used as pasture. This soil is generally unsuited to corn, soybeans, and small grain unless it is drained. Wetness and ponding are the main management concerns. If the soil is drained and cultivated, soil blowing is a hazard.

This soil is poorly suited to grasses and legumes for pasture and is generally unsuited to hay. Partially drained areas can be pastured. Water-tolerant grasses should be selected for planting. Because of low strength, the soil cannot support haying equipment. Because of the wetness, hay does not cure properly.

This soil is poorly suited to trees. Seedling mortality, plant competition, the windthrow hazard, and the equipment limitation are management concerns. Replanting of seedlings is often necessary. Water-tolerant species should be selected for planting. Competing vegetation can be controlled by cutting, girdling, or spraying. Carefully thinning the stands or not thinning them at all and applying harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Ordinary crawler tractors and rubber-tired skidders cannot be operated on this soil. Heavy equipment should be used only when the ground is frozen.

Because of the ponding and low strength, this soil is generally unsuitable as a site for dwellings, local roads, and septic tank absorption fields. Extensive changes are needed to make the soil suitable for these uses.

The land capability classification is Vw. The woodland ordination symbol is 2W.

Ht—Houghton muck, drained. This nearly level, deep, very poorly drained soil is in deep depressions on moraines, outwash plains, and terraces. It commonly is saturated and ponded by runoff from the higher adjacent slopes. Areas are oval or irregular in shape and are 2 to 95 acres in size.

Typically, the surface tier is black muck about 10 inches thick. Below this to a depth of 60 inches is black and dark reddish brown, friable muck. In some places coprogenous earth, marl, or sandy and loamy material is within a depth of 50 inches. In other places the surface tier is high in content of mineral material. In some areas the bottom tier has a higher content of fibers.

Included with this soil in mapping are small areas where the drainage system has failed and marsh vegetation has become established. Also included are small areas of the very poorly drained Granby, Mermill, Milford, Pewamo, and Rensselaer soils near the edge of the depressions and on slight rises. These soils are less mucky than the Houghton soil. Included soils make up 10 to 15 percent of the map unit.

The Houghton soil has a very high available water capacity. Permeability is moderately slow to moderately rapid. The water table is near or above the surface during winter and spring. Runoff is very slow or ponded. The surface layer has a very high organic matter content. This layer is friable, and tilth is good.

Most areas are used for cultivated crops. If drained, this soil is fairly well suited to corn, soybeans, and small grain. Ponding, wetness, and soil blowing are the major management concerns (fig. 7). Because of the poor stability of the organic material, ditchbanks can cave in and drainage tile can be impaired. If drained, the organic material subsides. It can subside so much that the drainage system is no longer adequate. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control soil blowing. Most pesticides are effective only if they are applied at a higher rate than is typical.

If drained, this soil is well suited to grasses for hay or pasture. Deep-rooted legumes, such as alfalfa, grow poorly because of ponding and the high water table. Because of the poor stability of the muck, haying equipment should be used only during dry periods. Because of the wetness, the hay does not cure properly.

This soil is poorly suited to trees. Seedling mortality, plant competition, the windthrow hazard, and the equipment limitation are management concerns. Replanting of seedlings is often necessary. Water-tolerant species should be selected for planting. Competing vegetation can be controlled by cutting, girdling, or spraying. Carefully thinning the stands or not thinning them at all and applying harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Ordinary crawler tractors and rubber-tired skidders cannot be operated on this soil. Heavy equipment should be used only when the ground is frozen.

Because of the ponding and low strength, this soil is generally unsuitable as a site for dwellings, local roads, and septic tank absorption fields. Extensive changes are needed to make the soil suitable for these uses.

The land capability classification is IIIw. The woodland ordination symbol is 2W.

KaA—Kalamazoo sandy loam, 0 to 2 percent slopes. This nearly level, deep, well drained soil is on river terraces, outwash plains, and moraines. Areas are elongated and are 3 to 20 acres in size.

Typically, the surface layer is dark brown sandy loam about 9 inches thick. The subsoil is about 38 inches thick. It is brown and dark brown, firm and friable sandy loam and gravelly sandy clay loam in the upper part and dark brown, friable gravelly sandy loam in the lower part. The underlying material to a depth of 60 inches is pale brown gravelly coarse sand. In some places the surface layer is darker. In other places it is loamy sand. In some areas the subsoil has less clay in the upper part and more clay in the lower part. In other areas the slope is more than 2 percent. In places the solum is less than 40 inches thick. In a few areas the soil has less gravel throughout. In some areas it is underlain by glacial till within a depth of 6 feet. In a few places a water table is within a depth of 6 feet.

Included with this soil in mapping are small areas of the somewhat poorly drained Homer soils on the lower parts of the landscape and the very poorly drained Sebewa soils in depressions. Included soils make up 4 to 12 percent of the map unit.

The Kalamazoo soil has a moderate available water capacity. Permeability is moderate in the upper part of the profile and rapid in the lower part. Runoff is slow.

Figure 7.—Soil blowing in an unprotected area of Houghton muck, drained.

The surface layer has a moderate organic matter content. This layer is friable, and tilth is good.

Most areas are used for cultivated crops. A few are used for hay, pasture, or woodland. This soil is a probable source of sand and gravel.

This soil is well suited to corn, soybeans, and small grain. It can be intensively row cropped if it is managed properly. Soil blowing and drought are hazards during extended dry periods. A few stones on or near the surface can hinder fieldwork. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface reduce the evaporation rate, help to control soil blowing, minimize crusting, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay or pasture. Pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying.

Because of the shrink-swell potential, this soil is moderately limited as a site for dwellings. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. Because of low strength and frost action, the soil is moderately limited as a site for local roads and streets. An adequate drainage system along the roads minimizes the damage caused by frost action. Replacing or strengthening the base with better suited material improves the ability of the roads and streets to support vehicular traffic.

Because of a poor filtering capacity, this soil is severely limited as a site for septic tank absorption fields. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. Filling or mounding with suitable material improves the ability of the field to filter the effluent.

The land capability classification is IIs. The woodland ordination symbol is 3A.

KaB—Kalamazoo sandy loam, 2 to 6 percent slopes. This gently sloping, deep, well drained soil is on river terraces, outwash plains, and moraines. Areas are elongated and are 3 to 15 acres in size.

Typically, the surface layer is dark brown sandy loam about 10 inches thick. The subsoil is about 34 inches thick. It is dark brown and dark yellowish brown, firm and friable clay loam and gravelly sandy clay loam in the upper part and dark brown and dark yellowish brown, friable to loose gravelly sandy loam, gravelly sandy clay loam, and loamy sand in the lower part. The underlying material to a depth of 60 inches is brown gravelly coarse sand. In some areas the surface layer is darker. In a few places it is loamy sand. In some places the subsoil has less clay in the upper part and more clay in the lower part. In other places the slope is less than 2 or more than 6 percent. In some areas the solum is less than 40 inches thick. In a few areas the soil is underlain by glacial till within a depth of 6 feet.

Included with this soil in mapping are small areas of the somewhat poorly drained Homer soils on the lower parts of the landscape and the very poorly drained Sebewa soils in depressions. Included soils make up 2 to 10 percent of the map unit.

The Kalamazoo soil has a moderate available water capacity. Permeability is moderate in the upper part of the profile and rapid in the lower part. Runoff is medium. The surface layer has a moderate organic matter content. This layer is friable, and tilth is good.

Most areas are used for cultivated crops. A few are used for hay, pasture, or woodland. This soil is a probable source of sand and gravel.

This soil is well suited to corn, soybeans, and small grain. Erosion is the main management concern. Soil blowing and drought are hazards during extended dry periods. A few stones on or near the surface can hinder fieldwork. A cropping system that includes grasses and legumes, diversions, grassed waterways, and grade stabilization structures help to prevent excessive runoff and soil loss. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control soil blowing and erosion, minimize crusting, reduce the evaporation rate, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay and pasture. Pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying.

Because of the shrink-swell potential, this soil is moderately limited as a site for dwellings. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. Retaining as much of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion. Because of low strength and frost action, the soil is moderately limited as a site for local roads and streets. An adequate drainage system along the roads minimizes the damage caused by frost action. Replacing or strengthening the base with better suited material improves the ability of the roads and streets to support vehicular traffic.

Because of a poor filtering capacity, this soil is severely limited as a site for septic tank absorption fields. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. Filling or mounding with suitable material improves the ability of the field to filter the effluent.

The land capability classification is IIe. The woodland ordination symbol is 3A.

MbB—Martinsville loam, 1 to 6 percent slopes. This gently sloping, deep, well drained soil is on river terraces, outwash plains, and moraines. Areas are elongated and are 2 to 20 acres in size.

Typically, the surface layer is dark brown loam about 10 inches thick. The subsoil is about 40 inches thick. It is dark brown and dark yellowish brown, firm and friable sandy clay loam and clay loam in the upper part and dark brown and yellowish brown, friable and firm sandy clay loam and loam in the lower part. The underlying material to a depth of 60 inches is brown, stratified loamy fine sand, fine sand, and sand. In places the surface layer is darker. In a few areas it is loamy sand. In some areas the soil is moderately eroded. In some places the subsoil has less clay, and in other places it has more clay. In some areas the seasonal high water table is within a depth of 6 feet. In other areas the slope is less than 1 or more than 6 percent. In places the solum is less than 40 or more than 60 inches thick. In a few areas the soil has gravel in the subsoil and underlying material. In a few places glacial till is within a depth of 6 feet.

Included with this soil in mapping are small areas of the very poorly drained Rensselaer soils in depressions and the somewhat poorly drained Whitaker soils on the lower parts of the landscape. Included soils make up 2 to 10 percent of the map unit.

The Martinsville soil has a high available water capacity. Permeability is moderate. Runoff is medium. The surface layer has a moderate organic matter content. This layer is friable, and tilth is good.

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

This soil is well suited to corn, soybeans, and small grain. The hazard of erosion is the main management concern. A cropping system that includes grasses and legumes, diversions, grassed waterways, and grade stabilization structures help to prevent excessive runoff and erosion. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control erosion, minimize crusting, reduce the evaporation rate, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay or pasture. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying.

This soil is suitable as a site for septic tank absorption fields. Because of shrink-swell potential, it is moderately limited as a site for dwellings. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. Retaining as much of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion.

Because of low strength, the shrink-swell potential, and frost action, this soil is moderately limited as a site for local roads and streets. An adequate drainage system along the roads minimizes the damage caused by shrinking and swelling and by frost action. Replacing or strengthening the base with better suited material improves the ability of the roads and streets to support vehicular traffic.

The land capability classification is IIe. The woodland ordination symbol is 4A.

MbC—Martinsville loam, 6 to 15 percent slopes. This moderately sloping, deep, well drained soil is on river terraces, outwash plains, and moraines. Areas are irregular in shape and are 2 to 8 acres in size.

Typically, the surface layer is dark brown loam about 9 inches thick. The subsoil is about 37 inches thick. The upper part is dark yellowish brown, dark brown, and strong brown, firm sandy clay loam and clay loam, and the lower part is dark brown and yellowish brown, friable sandy loam. The underlying material to a depth of 60 inches is pale brown sand and fine sand. In some areas the solum is less than 40 inches thick. In some places the subsoil has less clay, and in other places it has more clay. In some areas the soil is moderately eroded. In other areas the surface layer is darker. In a few places it is loamy fine sand. In some areas the subsoil and underlying material contain gravel. In other areas the soil is underlain by glacial till within a depth of 6 feet. In places the slope is less than 6 or more than 15 percent.

Included with this soil in mapping are small areas where the slope is more than 18 percent, small areas of severely eroded soils that have a surface layer of sandy clay loam, and small areas of soils that have a gravelly surface layer. Also included are small areas of the somewhat poorly drained Whitaker soils on foot slopes and on the lower parts of the landscape. Included soils make up 2 to 10 percent of the map unit.

The Martinsville soil has a high available water capacity. Permeability is moderate. Runoff is medium. The surface layer has a moderate organic matter content. This layer is friable, and tilth is good.

Most areas of this soil are used for cultivated crops. Some are used for hay or pasture. A few remain wooded.

This soil is fairly well suited to corn, soybeans, and small grain. The hazard of erosion is the main management concern. A cropping system that includes grasses and legumes, diversions, contour farming, grassed waterways, and grade stabilization structures help to control erosion and runoff. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control erosion, minimize crusting, reduce the evaporation rate, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay or pasture. Pasture rotation, timely deferment of grazing, and restricted use during wet periods minimize compaction, reduce the runoff rate, increase the rate of water infiltration, and help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying.

Because of the slope and shrink-swell potential, this soil is moderately limited as a site for dwellings. The buildings should be designed so that they conform to the natural slope of the land. Strengthening foundations and footings helps to prevent the structural damage caused by shrinking and swelling. Retaining as much of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion.

Because of the shrink-swell potential, frost action, and the slope, this soil is moderately limited as a site for local roads and streets. Replacing or covering the upper soil layers with suitable base material helps to prevent the damage caused by frost action and by shrinking and swelling. Constructing the roads and streets on the contour and land shaping help to overcome the slope.

Because of the slope, this soil is moderately limited as a site for septic tank absorption fields. Installing the absorption field on the contour helps to overcome this limitation.

The land capability classification is IIIe. The woodland ordination symbol is 4A.

Md—Martisco muck, drained. This nearly level, deep, very poorly drained soil is in deep depressions on outwash plains and terraces and along the edges of lakes. It is subject to flooding. During spring it commonly is saturated and ponded by springs and by runoff from the higher adjacent slopes. Areas are oval or irregular in shape and are 2 to 30 acres in size.

Typically, the surface layer is black muck about 12 inches thick. The underlying material to a depth of 60 inches is white, light brownish gray, grayish brown, and dark gray, mottled, friable marl. In a few places the organic material is more than 16 inches thick. In some areas mineral layers overlie the marl. In many areas coprogenous earth or sandy and loamy mineral material is within 50 inches of the surface.

Included with this soil in mapping are undrained areas or areas where the drainage system has failed and marsh vegetation has become established. Also included are small areas of the very poorly drained Milford and Rensselaer soils near the edge of the depressions and on slight rises. These soils are less mucky than the Martisco soil. Included soils make up 8 to 20 percent of the map unit.

The Martisco soil has a high available water capacity. Permeability is slow to moderate. The water table is near or above the surface during winter and spring. Runoff is very slow or ponded. The surface layer is very high in organic matter content. This layer is very friable, and tilth is good.

Some areas of this soil are used for cultivated crops. Some support marsh vegetation. A few are used as pasture.

This soil is poorly suited to corn, soybeans, and small grain. Wetness and soil blowing are the main management concerns. Most crops grow poorly in the undrained areas. Draining this soil is difficult in most areas. Many areas do not have an adequate drainage outlet. Because of the poor stability of the organic material, ditchbanks cave in. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control soil blowing. Most pesticides are effective only if they are applied at a higher rate than is typical.

This soil is fairly well suited to grasses, such as reed canarygrass, for hay. It is well suited to pasture. Deep-rooted legumes, such as alfalfa, grow poorly because of the ponding and the high water table. The use of haying equipment is restricted to dry periods because of the poor stability of the muck. Because of the wetness, hay commonly does not cure properly.

This soil is poorly suited to trees. Seedling mortality, plant competition, the windthrow hazard, and the equipment limitation are management concerns. Replanting of seedlings is often necessary. Water-tolerant species should be selected for planting. Competing vegetation can be controlled by cutting, girdling, or spraying. Carefully thinning the stands or not thinning them at all and applying harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Ordinary crawler tractors and rubber-tired skidders cannot be operated on this soil. Heavy equipment should be used only when the ground is frozen.

Because of the ponding and the flooding, this soil is generally unsuitable as a site for dwellings, local roads, and septic tank absorption fields. Extensive changes are needed to make the soil suitable for these uses.

The land capability classification is IIIw. The woodland ordination symbol is 4W.

Mg—Mermill loam. This nearly level, deep, very poorly drained soil is in depressions on till plains and in narrow drainageways on moraines. It is ponded by runoff from the higher adjacent slopes. Areas are irregular in shape and are 3 to 15 acres in size.

Typically, the surface layer is very dark gray loam about 9 inches thick. The subsoil is about 47 inches thick. The upper part is dark gray and gray, mottled, firm and friable clay loam and sandy clay loam. The lower part is dark gray and grayish brown, mottled, firm clay loam. The underlying material to a depth of 60 inches is yellowish brown, mottled clay loam. In many places the dark surface soil is more than 10 inches thick. In some areas the solum is more than 60 inches thick. In other areas a thin layer of stratified sandy material is directly above the glacial underlying material. In places the upper part of the solum formed in a mantle of lacustrine material.

Included with this soil in mapping are undrained areas in woodlots and deep depressions. These areas stay wet most of the year. Also included are areas of the somewhat poorly drained Haskins soils on slight rises; the moderately well drained Rawson soils on the higher, more sloping parts of the landscape; the very poorly drained Granby soils on the lower parts; and the very poorly drained Houghton and Palms soils in deep depressions. Granby soils are more sandy than the

Mermill soil. Houghton and Palms soils are mucky. Included soils make up 5 to 15 percent of the map unit.

The Mermill soil has a high available water capacity. Permeability is moderate in the upper part of the profile and slow in the lower part. The water table is near or above the surface in winter and early spring. Runoff is very slow or ponded. The surface layer has a high organic matter content. This layer is friable, and tilth is good.

Most areas of this soil are used for cultivated crops. Some are used for hay or pasture. A few are wooded, but many of these are being cleared and drained for cultivation.

If drained, this soil is well suited to corn, soybeans, and small grain. If drained and properly managed, it can be intensively row cropped. Wetness and ponding are the main management concerns. Growing crops is difficult in undrained areas. Shallow surface drains and subsurface drains can remove excess water if adequate outlets are available. In some areas preparing a suitable seedbed is difficult. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface minimize crusting, improve tilth, and increase the rate of water infiltration. The soil is well suited to fall plowing.

This soil is well suited to grasses, such as reed canarygrass, for hay or pasture. Deep-rooted legumes, such as alfalfa, grow poorly in inadequately drained areas because they cannot withstand the high water table or the temporary ponding. Even if subsurface drains are installed, the legumes can be damaged during brief periods of ponding. Overgrazing or grazing when the soil is wet results in surface compaction and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is fairly well suited to trees. Seedling mortality, the windthrow hazard, the equipment limitation, and plant competition are management concerns. Replanting of seedlings is often necessary. Water-tolerant species should be selected for planting. Competing vegetation can be controlled by cutting, girdling, or spraying. Carefully thinning the stands or not thinning them at all and applying harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Harvesting activities are restricted to dry periods or to periods when the ground is frozen.

Because of the ponding, this soil is generally unsuitable as a site for dwellings and septic tank absorption fields. It is severely limited as a site for local roads because of frost action and ponding. Constructing the roads on raised, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by ponding and frost action.

The land capability classification is IIw. The woodland ordination symbol is 4W.

MmB2—Miami sandy loam, 2 to 6 percent slopes, eroded. This gently sloping, deep, well drained soil is on moraines. Areas are irregular in shape and are 2 to 25 acres in size.

Typically, the surface layer is dark grayish brown sandy loam about 8 inches thick. It is mixed with chunks of yellowish brown clay loam. The subsoil is about 22 inches of yellowish brown and dark yellowish brown, firm loam and clay loam. The underlying material to a depth of 60 inches is yellowish brown loam. In places the soil has a mantle of loess or loamy outwash more than 18 inches thick. In a few areas the surface layer is loamy sand. In some places the solum is more than 40 inches thick. In other places the content of clay in the subsoil averages less than 27 or more than 35 percent. In some areas the underlying material is sandy loam. In some places the soil is only slightly eroded. In other places it is severely eroded. In some areas the slope is more than 6 percent.

Included with this soil in mapping are small areas of the somewhat poorly drained Crosier and very poorly drained Brookston soils on foot slopes, along narrow waterways, and in small depressions. Also included are short breaks where the slope is more than 12 percent. Included soils make up 5 to 15 percent of the map unit.

The Miami soil has a high available water capacity. Permeability is moderately slow. Runoff is medium. The surface layer has a moderately low organic matter content. This layer is friable, and tilth is fair.

Most areas of this soil are used for cultivated crops. Some are used for hay or pasture. A few remain wooded.

This soil is well suited to corn, soybeans, and small grain. Erosion and soil blowing are the main management concerns. A few cobbles and stones on or near the surface can hinder fieldwork. A cropping system that includes grasses and legumes, diversions, contour farming, grassed waterways, and grade stabilization structures help to control erosion and runoff. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control erosion and soil blowing, minimize crusting, improve tilth, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay or pasture. Overgrazing or grazing when the soil is wet results in surface compaction, excessive runoff, and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying.

Because of shrink-swell potential, this soil is moderately limited as a site for dwellings. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. Retaining as much of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion. Because of frost action and the shrink-swell potential, the soil is moderately limited as a site for local roads and streets. Replacing the base with better suited material and installing an adequate drainage system along the roads help to prevent the damage caused by frost action and by shrinking and swelling.

Because of the moderately slow permeability, this soil is severely limited as a site for septic tank absorption fields. Enlarging the absorption field helps to compensate for the restricted permeability.

The land capability classification is IIe. The woodland ordination symbol is 4A.

MmC2—Miami sandy loam, 6 to 12 percent slopes, eroded. This moderately sloping, deep, well drained soil is on moraines. Areas are irregular in shape and are 3 to 20 acres in size.

Typically, the surface layer is dark brown sandy loam about 8 inches thick. It is mixed with chunks of yellowish brown clay loam. The subsoil is about 17 inches of yellowish brown, firm clay loam and loam. The underlying material to a depth of 60 inches is yellowish brown loam. In some places the soil is not eroded or is only slightly eroded. In other places it is severely eroded. In some areas the solum is less than 24 or more than 40 inches thick. In other areas it formed in more than 18 inches of loamy outwash. In a few places the surface layer is loamy sand. In some areas the content of clay in the subsoil averages less than 27 or more than 35 percent. In other areas the underlying material is sandy loam. In places the slope is less than 6 or more than 12 percent.

Included with this soil in mapping are small areas of the somewhat poorly drained Crosier soils on foot slopes and along narrow drainageways. Also included are short breaks where the slope is more than 18 percent. Included soils make up 4 to 12 percent of the map unit.

The Miami soil has a high available water capacity. Permeability is moderately slow. Runoff is medium. The surface layer has a moderately low organic matter content. This layer is friable, and tilth is fair.

Most areas of this soil are used for cultivated crops. Some are used for hay or pasture. A few remain wooded.

This soil is fairly well suited to corn, soybeans, and small grain. Erosion and soil blowing are the main management concerns. A few cobbles and stones on or near the surface can hinder fieldwork. A cropping system that includes grasses and legumes, diversions, contour farming, grassed waterways, and grade stabilization structures help to control erosion and runoff. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control erosion and soil blowing, minimize crusting, improve tilth, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay or pasture. Overgrazing or grazing when the soil is wet results in surface compaction, excessive runoff, and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying.

Because of the slope and shrink-swell potential, this soil is moderately limited as a site for dwellings. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. The buildings should be designed so that they conform to the natural slope of the land. Retaining as much of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion.

Because of the shrink-swell potential, the slope, and frost action, this soil is moderately limited as a site for local roads and streets. Constructing the roads on the contour and land shaping help to overcome the slope. Replacing the base with better suited material and installing an adequate drainage system along the roads help to prevent the damage caused by frost action and by shrinking and swelling.

Because of the moderately slow permeability, this soil is severely limited as a site for septic tank absorption fields. Enlarging the absorption field helps to compensate for the restricted permeability. Installing the absorption field on the contour helps to achieve an even distribution of the effluent.

The land capability classification is IIIe. The woodland ordination symbol is 4A.

MmD2—Miami sandy loam, 12 to 18 percent slopes, eroded. This strongly sloping, deep, well drained soil is on moraines and on the breaks between uplands and bottom land. Areas are long and narrow and range from 2 to 15 acres in size.

Typically, the surface layer is dark grayish brown sandy loam about 7 inches thick. It is mixed with chunks of yellowish brown clay loam. The subsoil is yellowish brown, firm clay loam about 19 inches thick. The underlying material to a depth of 60 inches is yellowish brown loam. In a few places the solum is less than 20 inches thick. In wooded areas and areas that have not been heavily farmed, the soil is not eroded or is only slightly eroded. In some places the content of clay in the subsoil averages less than 27 or more than 35 percent. In other places the underlying material is sandy loam. In some areas the slope is less than 12 or more than 18 percent.

Included with this soil in mapping are small areas of severely eroded soils that have a surface layer of clay loam, areas of soils that formed in small pockets of sand or gravel, and small breaks where the slope is more than 30 percent. Also included are a few small areas where the surface layer is loamy sand and small areas of the somewhat poorly drained Crosier and well drained Hennepin soils. Crosier soils are along small waterways. Hennepin soils are on steep breaks. Their solum is thinner than that of the Miami soil. Included soils make up 2 to 15 percent of the map unit.

The Miami soil has a high available water capacity. Permeability is moderately slow. Runoff is rapid. The surface layer has a moderately low organic matter content. This layer is friable, and tilth is fair.

Most areas of this soil are used for hay or pasture. Many remain wooded or are being reforested. A few are used for cultivated crops.

This soil is poorly suited to corn, soybeans, and small grain. Erosion and soil blowing are the main management concerns. A few stones on or near the surface can hinder fieldwork. A crop rotation that includes meadow crops and small grain, diversions, grassed waterways, and contour farming help to control erosion and runoff. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control erosion and soil blowing, minimize crusting, improve tilth, and increase the rate of water infiltration. The soil is well suited to no-till farming.

Because of the slope, this soil is only fairly well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay. It is well suited to pasture. Overgrazing or grazing when the soil is wet results in surface compaction, excessive runoff, and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying.

Because of the slope, this soil is severely limited as a site for dwellings and for local roads and streets. Buildings should be designed so that they conform to the natural slope of the land. Land shaping and retaining walls also help to overcome the slope. Retaining as much of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion. Cutting and filling are needed on sites for local roads and streets. Also, the roads should be built on the contour if possible. Strengthening or replacing the base with better suited material improves the ability of the roads and streets to support vehicular traffic.

This soil is severely limited as a site for septic tank absorption fields because of the slope and the moderately slow permeability. Enlarging the absorption field improves the ability of the field to absorb the effluent. Installing the absorption field on the contour helps to achieve an even distribution of the effluent.

The land capability classification is IVe. The woodland ordination symbol is 4A.

MmE2—Miami sandy loam, 18 to 25 percent slopes, eroded. This moderately steep, deep, well drained soil is on the breaks between uplands and bottom land and on the more rolling moraines. Areas are long and narrow and range from 2 to 15 acres in size.

Typically, the surface layer is dark brown sandy loam about 7 inches thick. It is mixed with chunks of dark yellowish brown clay loam. The subsoil is about 17 inches of dark yellowish brown and yellowish brown, firm clay loam and loam. The underlying material to a depth of 60 inches is yellowish brown loam. In some areas the solum is less than 20 inches thick. In some places the soil is not eroded or is only slightly eroded. In other places it is severely eroded. In some areas the content of clay in the subsoil averages less than 27 or more than 35 percent. In other areas the soil is underlain by sandy loam till. In places the slope is less than 18 or more than 25 percent.

Included with this soil in mapping are small areas of the well drained Hennepin soils on steep breaks. These soils have a solum that is thinner than that of the Miami soil. They make up 2 to 10 percent of the map unit.

The Miami soil has a high available water capacity. Permeability is moderately slow. Runoff is rapid. The surface layer has a moderately low organic matter content. This layer is friable, and tilth is fair.

Most areas are used for hay or pasture. Some remain wooded or are being planted to trees. A few are used for cultivated crops. Because of the hazard of erosion, this soil is generally unsuited to corn, soybeans, and small grain. Because of the slope, it is poorly suited to hay and is only fairly well suited to pasture. Grasses, such as orchardgrass, and legumes, such as alfalfa, grow well. The use of haying equipment can be hazardous on these slopes. Overgrazing or grazing when the soil is wet results in surface compaction, excessive runoff, and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is fairly well suited to trees. Plant competition, the erosion hazard, and the equipment limitation are the main management concerns. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying. The slope limits the types of equipment that can be operated safely on this soil. Because of the erosion hazard, heavy equipment should not be used. The erosion hazard can be reduced by constructing logging roads on the contour and by installing water bars.

Because of the slope, this soil is generally unsuitable as a site for dwellings and sanitary facilities and is severely limited as a site for local roads. The roads should be built on the contour. Land shaping may be needed. Areas disturbed during construction should be revegetated as soon as possible.

The land capability classification is VIe. The woodland ordination symbol is 4R.

MoC3—Miami clay loam, 6 to 12 percent slopes, severely eroded. This moderately sloping, deep, well drained soil is on moraines. Areas are irregular in shape and are 3 to 15 acres in size.

Typically, the surface layer is dark yellowish brown clay loam about 7 inches thick. In most areas, nearly all of the original darkened surface layer has been removed by erosion and tillage has mixed the rest with the upper part of the subsoil. The subsoil is yellowish brown and brown, firm clay loam about 17 inches thick. The underlying material to a depth of 60 inches is yellowish brown loam. In many places the solum is less than 20 inches thick. In areas on concave foot slopes and in waterways, the soil is only slightly or moderately eroded. In some areas it is very severely eroded. In some places the content of clay in the subsoil averages less than 27 percent. In other places the underlying material is sandy loam. In some areas the slope is less than 6 or more than 12 percent.

Included with this soil in mapping are small breaks where the slope is more than 18 percent and areas of soils that formed in small pockets of sand or gravel. Also included are small areas of the somewhat poorly drained Crosier soils on foot slopes and along narrow drainageways. Included soils make up 5 to 10 percent of the map unit.

The Miami soil has a high available water capacity. Permeability is moderately slow. Runoff is rapid. The surface layer has a low organic matter content. This layer is firm, and tilth is poor.

Most areas of this soil are used for cultivated crops. Some are used for hay or pasture. A few are being naturally reforested.

This soil is poorly suited to corn, soybeans, and small grain. Erosion is the main management concern. Preparing a suitable seedbed is difficult because the clay loam surface layer stays wet for long periods and becomes cloddy as it dries. A few cobbles and stones on or near the surface can hinder fieldwork. A cropping system that includes grasses and legumes, diversions, grassed waterways, and grade stabilization structures help to control erosion and runoff. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control erosion, minimize crusting, improve tilth, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is fairly well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay. It is well suited to pasture. Overgrazing or grazing when the soil is wet results in severe surface compaction, excessive runoff, and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying.

Because of the shrink-swell potential and the slope, this soil is moderately limited as a site for dwellings. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. The buildings should be designed so that they conform to the natural slope of the land. Retaining as much of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion.

Because of the shrink-swell potential, the slope, and frost action, this soil is moderately limited as a site for local roads and streets. Constructing the roads on the contour and land shaping help to overcome the slope. Replacing the base with better suited material and installing an adequate drainage system along the roads help to prevent the damage caused by frost action and by shrinking and swelling.

Because of the moderately slow permeability, this soil is severely limited as as site for septic tank absorption fields. Enlarging the absorption field helps to compensate for the restricted permeability.

The land capability classification is IVe. The woodland ordination symbol is 4A.

MoD3—Miami clay loam, 12 to 20 percent slopes, severely eroded. This strongly sloping, deep, well drained soil is on the breaks between uplands and bottom land and on the more rolling moraines. Areas are irregular in shape and are 2 to 20 acres in size.

Typically, the surface layer is dark yellowish brown clay loam about 9 inches thick. In most areas, nearly all of the original darkened surface layer has been removed by erosion and tillage has mixed the rest with the upper part of the subsoil. The subsoil is dark yellowish brown and yellowish brown, firm clay loam about 15 inches thick. The underlying material to a depth of 60 inches is brown loam. In many places the solum is less than 20 inches thick. In some places the soil is only slightly or moderately eroded. In other places it is very severely eroded. In some areas the content of clay in the subsoil averages less than 27 percent. In other areas the underlying material is sandy loam. In places the slope is less than 12 or more than 20 percent.

Included with this soil in mapping are areas of soils that formed in sand or gravel and small areas of the well drained Hennepin soils on steep breaks. Hennepin soils have a solum that is thinner than that of the Miami soil. Included soils make up 2 to 12 percent of the map unit.

The Miami soil has a high available water capacity. Permeability is moderately slow. Runoff is very rapid. The surface layer has a low organic matter content. This layer is firm, and tilth is poor.

Most areas are used for cultivated crops. Many are used for hay or pasture. A few are being reforested. Because of the hazard of erosion, this soil is generally unsuited to corn, soybeans, and small grain. It is poorly suited to hay and fairly well suited to pasture. Overgrazing or grazing when the soil is wet results in severe surface compaction, excessive runoff, and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying.

Because of the slope, this soil is severely limited as a site for dwellings and for local roads and streets. Buildings should be designed so that they conform to the natural slope of the land, and roads should be built on the contour. Land shaping and installing retaining walls also help to overcome the slope. Retaining as much of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion.

Because of the slope and the moderately slow permeability, this soil is severely limited as a site for septic tank absorption fields. Enlarging the absorption field helps to compensate for the restricted permeability. Installing the absorption field on the contour helps to overcome the slope.

The land capability classification is VIe. The woodland ordination symbol is 4A.

Ms—Milford silty clay loam. This nearly level, deep, very poorly drained soil is in deep depressions and small glacial lakebeds on till plains and moraines. It is often ponded by runoff from the higher adjacent slopes. Areas are irregular in shape and are 3 to 30 acres in size.

Typically, the surface is black silty clay loam about 8 inches thick. The subsurface layer is about 5 inches of black silty clay. The subsoil is dark gray and gray, mottled, firm silty clay about 29 inches thick. The underlying material to a depth of 60 inches is gray, mottled, stratified silty clay loam and silty clay. In places the dark surface soil is less than 10 inches thick. In many areas the underlying material becomes coarser textured with increasing depth and has strata of loamy fine sand to gravelly sand. In some areas glacial till is within a depth of 48 inches. In other areas the surface soil is lighter colored alluvial material as much as 3 feet thick.

Included with this soil in mapping are small undrained areas in depressions that stay wet most of the year. In some of these undrained areas, the soil has a thin surface layer of muck. Also included are small areas of the very poorly drained Boots, Houghton, Martisco, and Muskego soils in the deep depressions and the somewhat poorly drained Fulton soils on the higher areas. Boots, Houghton, Martisco, and Muskego soils are mucky. Included soils make up 2 to 10 percent of the map unit.

The Milford soil has a high available water capacity. Permeability is moderately slow. The water table is near or above the surface during winter and spring. Runoff is very slow or ponded. The surface layer has a high organic matter content. This layer is firm, and tilth is fair.

Most areas of this soil are used for cultivated crops. Some support marsh vegetation or are wooded. A few are used for hay or pasture.

If drained, this soil is well suited to corn, soybeans, and small grain. If drained and properly managed, it can be intensively row cropped. Wetness and ponding are the main management concerns. Crops grow poorly in undrained areas. Shallow surface drains and subsurface drains can remove excess water if adequate outlets are available. In some areas these outlets are not readily available. Fine sand can flow into subsurface drains and clog them. Preparing a seedbed is difficult because the surface layer is silty clay loam. Working this soil at the correct moisture content minimizes compaction and helps to maintain good soil structure. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface minimize crusting, improve tilth, and increase the rate of water infiltration. The soil is well suited to fall plowing.

If drained, this soil is well suited to grasses, such as orchardgrass, and legumes, such as ladino clover, for hay or pasture. Deep-rooted legumes, such as alfalfa, grow poorly in inadequately drained areas. Even if subsurface drains are installed, the legumes can be damaged during brief periods of ponding. Overgrazing or grazing when the soil is wet results in surface compaction and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

Because of the ponding, this soil is generally unsuitable as a site for dwellings and sanitary facilities. It is severely limited as a site for local roads because of the ponding, low strength, and frost action. Constructing the roads on raised, well compacted fill material and providing adequate ditches and culverts help to prevent the road damage caused by ponding and frost action. Strengthening or replacing the base with better suited material improves the ability of the roads to support vehicular traffic.

The land capability classification is IIw. No woodland ordination symbol is assigned.

MvB2—Morley loam, 3 to 6 percent slopes, eroded. This gently sloping, deep, well drained soil is on till plains and moraines. Areas are irregular in shape and are 3 to 35 acres in size.

Typically, the surface layer is dark grayish brown loam about 10 inches thick. It is mixed with yellowish brown clay loam. The subsoil is about 14 inches of yellowish brown and dark yellowish brown, firm clay and clay loam. The underlying material to a depth of 60 inches is yellowish brown clay loam. In some wooded or pastured areas, the soil is only slightly eroded. In some places the solum is less than 20 inches thick. In other places the lower part of the subsoil is mottled. In some areas the subsoil and underlying material have less clay. In a few areas the soil is underlain by stratified silt and fine sand. In some places it formed in a loamy outwash mantle as much as 36 inches thick. In other places the surface layer is sandy loam. In a few areas the slope is more than 6 percent.

Included with this soil in mapping are small areas of severely eroded soils that have a surface layer of clay loam. Also included are soils that formed in sand and gravel, small breaks that have a slope of more than 12 percent, and small areas of the somewhat poorly drained Blount and moderately well drained Seward soils. Blount soils are on foot slopes and along narrow drainageways. Seward soils are on ridges. They are more sandy than the Morley soil. Included soils make up 4 to 15 percent of the map unit.

The Morley soil has a moderate available water capacity. Permeability is slow. Runoff is medium. The surface layer has a moderately low organic matter content. This layer is friable, and tilth is fair.

Most areas of this soil are used for cultivated crops. Some are used for hay or pasture. A few remain wooded, but many of these are being cleared for cultivation.

This soil is well suited to corn, soybeans, and small grain. The hazard of erosion is the main management concern. A few cobbles and stones on or near the surface can hinder fieldwork. A cropping system that includes grasses and legumes, diversions, grassed waterways, and grade stabilization structures help to control erosion and runoff. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control erosion, minimize crusting, improve tilth, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay or pasture. Overgrazing or grazing when the soil is too wet results in surface compaction, excessive runoff, and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying.

Because of the shrink-swell potential, this soil is moderately limited as a site for dwellings. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. The soil is severely limited as a site for local roads and streets because of low strength. Strengthening or replacing the base with better suited material improves the ability of the roads and streets to support vehicular traffic. Because of the slow permeability, the soil is severely limited as a site for septic tank absorption fields. Enlarging the absorption area or providing suitable fill material improves the ability of the field to absorb the effluent.

The land capability classification is IIe. The woodland ordination symbol is 4A.

MvC2—Morley loam, 6 to 12 percent slopes, eroded. This moderately sloping, deep, well drained soil is on till plains and moraines. Areas are irregular in shape and are 3 to 20 acres in size.

Typically, the surface layer is dark brown loam about 8 inches thick. It is mixed with chunks of dark yellowish brown clay loam. The subsoil is about 17 inches of dark yellowish brown and yellowish brown, firm clay and clay loam. The underlying material to a depth of 60 inches is yellowish brown clay loam. In some places the soil is only slightly eroded. In other places it is severely eroded and has a surface layer of clay loam. In some areas the lower part of the subsoil is mottled. In other areas the solum is less than 20 inches thick. In some places the subsoil and underlying material have less clay. In other places the soil formed in 30 inches of loamy outwash. In some areas the surface layer is sandy loam. In a few areas the underlying material is stratified silt and fine sand. In places the slope is less than 7 or more than 12 percent.

Included with this soil in mapping are small areas of the somewhat poorly drained Blount soils on foot slopes and along narrow drainageways, the well drained Hennepin soils on steep breaks, and the moderately well drained Seward soils on ridges. Hennepin soils are less clayey than the Morley soil, and Seward soils are more sandy. Also included are small breaks where the slope is more than 20 percent. Included soils make up 4 to 15 percent of the map unit.

The Morley soil has a moderate available water capacity. Permeability is slow. Runoff is medium. The surface layer has a moderately low organic matter content. This layer is friable, and tilth is fair.

Most areas of this soil are used for cultivated crops. Some are used for hay or pasture. A few remain wooded.

This soil is fairly well suited to corn, soybeans, and small grain. Erosion is the main management concern. A few cobbles and stones on or near the surface can hinder fieldwork. A cropping system that includes grasses and legumes, diversions, grassed waterways, and grade stabilization structures help to control erosion and runoff. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control erosion, minimize crusting, improve tilth, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay or pasture. Overgrazing or grazing when the soil is wet results in surface compaction, excessive runoff, and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying.

Because of the shrink-swell potential and the slope, this soil is moderately limited as a site for dwellings. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. The buildings should be designed so that they conform to the natural slope of the land. Disturbing as little of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion. Because of low strength, the soil is severely limited as a site for local roads and streets. Strengthening or replacing the base with better suited material improves the ability of the roads and streets to support vehicular traffic.

Because of the slow permeability, this soil is severely limited as a site for septic tank absorption fields. Enlarging the absorption field helps to compensate for the restricted permeability.

The land capability classification is IIIe. The woodland ordination symbol is 4A.

MvD2—Morley loam, 12 to 20 percent slopes, eroded. This strongly sloping, deep, well drained soil is on the breaks between uplands and bottom land and on the more rolling moraines. Areas are long and narrow and are 2 to 15 acres in size.

Typically, the surface layer is dark grayish brown loam about 7 inches thick. It is mixed with chunks of yellowish brown clay. The subsoil is about 16 inches of yellowish brown and brown, firm clay and clay loam. The underlying material to a depth of 60 inches is yellowish brown clay loam. In many places the solum is less than 20 inches thick. In some places the soil is not eroded or is only slightly eroded. In other places it is severely eroded and has a surface layer of clay loam. In a few areas the underlying material is stratified silt and fine sand. In some areas the subsoil and underlying material have less clay. In other areas the surface layer is sandy loam. In places the slope is less than 12 or more than 20 percent.

Included with this soil in mapping are small areas of the somewhat poorly drained Blount soils along small drainageways and the well drained Hennepin soils on steep breaks. Hennepin soils are less clayey than the Morley soil. Also included are small breaks where the slope is more than 30 percent. Included soils make up 2 to 12 percent of the map unit.

The Morley soil has a moderate available water capacity. Permeability is slow. Runoff is rapid. The surface layer has a moderately low organic matter content. This layer is friable, and tilth is fair.

Most areas of this soil are used for hay or pasture. Some remain wooded or are being naturally reforested. A few are used for cultivated crops.

This soil is poorly suited to corn, soybeans, and small grain. Erosion is the main management concern. A few stones on or near the surface can hinder fieldwork. Diversions, grassed waterways, grade stabilization structures, and a cropping sequence that includes small grain and meadow crops help to control erosion and runoff (fig. 8). Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control erosion, minimize crusting, improve tilth, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is fairly well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay. It is well suited to pasture. Overgrazing or grazing when the soil is wet results in surface compaction, excessive runoff, and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to trees. Plant competition, the erosion hazard, and the equipment limitation are the main management concerns. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying. The slope limits the types of equipment that can be operated safely on this soil. Restricting the use of heavy equipment, constructing logging roads on the contour, and installing water bars help to control erosion.

Because of the slope, this soil is severely limited as a site for dwellings. The buildings should be designed so that they conform to the natural slope of the land. Land shaping and retaining walls also help to overcome the slope. Retaining as much of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion. Because of the slope and low strength, the soil is severely limited as a site for local roads and streets.

Figure 8.—Small grain and meadow crops on Morley loam, 12 to 20 percent slopes, eroded.

Constructing the roads and streets on the contour and land shaping help to overcome the slope. Strengthening or replacing the base with better suited material improves the ability of the roads and streets to support vehicular traffic.

Because of the slope and the slow permeability, this soil is severely limited as a site for septic tank absorption fields. Installing the absorption field on the contour helps to overcome the slope. Enlarging the absorption area and controlling the rate of flow from a holding tank improve the ability of the field to absorb the effluent.

The land capability classification is IVe. The woodland ordination symbol is 4R.

MvE2—Morley loam, 20 to 30 percent slopes, eroded. This deep, moderately steep and steep, well drained soil is on the breaks between uplands and bottom land and on the more rolling moraines. Areas are long and narrow and are 2 to 15 acres in size.

Typically, the surface layer is dark grayish brown loam about 5 inches thick. It is mixed with chunks of dark yellowish brown clay. The subsoil is about 17 inches of brown and yellowish brown, firm clay and clay loam. The underlying material to a depth of 60 inches is yellowish brown clay loam. In many areas the solum is less than 20 inches thick. In some places the soil formed in a loamy outwash mantle as much as 20 inches thick. In other places the subsoil and underlying material have less clay. In wooded areas and areas that have not been heavily farmed, the soil is not eroded or is only slightly eroded. In a few places the slope is less than 20 or more than 30 percent.

Included with this soil in mapping are small areas of severely eroded soils that have a surface layer of clay loam, areas of soils that formed in sand and gravel, and small areas of the well drained Hennepin soils on steep breaks. Hennepin soils are less clayey than the Morley soil. Included soils make up 2 to 10 percent of the map unit.

The Morley soil has a moderate available water capacity. Permeability is slow. Runoff is rapid. The surface layer has a moderately low organic matter content. This layer is friable, and tilth is fair.

Most areas are used for hay or pasture. Many are wooded or are being reforested. A few are used for cultivated crops. Because of the hazard of erosion, this soil is generally unsuited to corn, soybeans, and small grain. It is poorly suited to hay and fairly well suited to pasture. The slope limits the types of equipment that can be operated safely on this soil. Overgrazing or grazing when the soil is too wet results in surface compaction, excessive runoff, and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to trees. Plant competition, the erosion hazard, and the equipment limitation are management concerns. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying. The types of equipment that can be operated safely on these slopes are limited. Restricting the use of heavy equipment, constructing logging roads on the contour, and installing water bars help to control erosion.

Because of the slope, this soil is generally unsuitable as a site for dwellings and sanitary facilities. It is severely limited as a site for local roads and streets because of the slope and low strength. The roads should be built on the contour. Cutting and filling may be needed. Strengthening or replacing the base with better suited material improves the ability of the roads and streets to support vehicular traffic. Areas disturbed during construction should be revegetated as soon as possible.

The land capability classification is VIe. The woodland ordination symbol is 4R.

MxC3—Morley clay loam, 5 to 12 percent slopes, severely eroded. This moderately sloping, deep, well drained soil is on till plains and moraines. Areas are irregular in shape and are 3 to 35 acres in size.

Typically, the surface layer is dark brown clay loam about 9 inches thick. In most areas, nearly all of the original darkened surface layer has been removed by erosion and tillage has mixed the rest with the upper part of the subsoil. The subsoil is about 13 inches of dark yellowish brown and yellowish brown, firm clay and clay loam. The underlying material to a depth of 60 inches is brown clay loam. In many areas the solum is less than 20 inches thick. In some areas the lower part of the subsoil is mottled. In some places the soil is only slightly or moderately eroded. In other places it is severely eroded. In some areas the subsoil and underlying material have less clay. In a few areas the underlying material is stratified silt and fine sand. In places the slope is less than 5 or more than 12 percent.

Included with this soil in mapping are small breaks where the slope is more than 20 percent. Also included are areas of soils that formed in sand and gravel and small areas of the somewhat poorly drained Blount soils on foot slopes and along narrow drainageways, the well drained Hennepin soils on steep breaks, and the moderately well drained Seward soils on ridges. Hennepin soils are less clayey than the Morley soil, and Seward soils are more sandy. Included soils make up 5 to 15 percent of the map unit.

The Morley soil has a moderate available water capacity. Permeability is slow. Runoff is rapid. The surface layer has a low organic matter content. This layer is firm, and tilth is poor.

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

This soil is poorly suited to corn, soybeans, and small grain. Erosion is the main management concern. Preparing a seedbed is difficult because the surface layer is clay loam. The soil stays wet for long periods and becomes cloddy as it dries. A few cobbles and stones on or near the surface can hinder fieldwork. A cropping system that includes grasses and legumes, diversions, grassed waterways, and grade stabilization structures help to control erosion and runoff. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control erosion, minimize crusting, improve tilth, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is fairly well suited to grasses, such as orchardgrass and bromegrass, and legumes, such as alfalfa and red clover, for hay. It is well suited to pasture. Overgrazing or grazing when the soil is wet results in surface compaction, excessive runoff, and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying.

Because of shrink-swell potential and the slope, this soil is moderately limited as a site for dwellings. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. The buildings should be designed so that they conform to the natural slope of the land. Retaining as much of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion. Because of low strength, the soil is severely limited as a site for local roads and streets. Strengthening or replacing the base with better suited material improves the ability of the roads and streets to support vehicular traffic.

Because of the slow permeability, this soil is severely limited as a site for septic tank absorption fields.

Enlarging the absorption area and controlling the rate of flow from a holding tank improve the ability of the field to absorb the effluent.

The land capability classification is IVe. The woodland ordination symbol is 4A.

MxD3—Morley clay loam, 12 to 20 percent slopes, severely eroded. This strongly sloping, deep, well drained soil is on the breaks between uplands and bottom land and on the more rolling moraines. Areas are irregular in shape and are 2 to 20 acres in size.

Typically, the surface layer is dark yellowish brown clay loam about 6 inches thick. In most areas, nearly all of the original darkened surface layer has been removed by erosion and tillage has mixed the rest with the upper part of the subsoil. The subsoil is about 15 inches of dark yellowish brown and yellowish brown, firm clay and clay loam. The underlying material to a depth of 60 inches is yellowish brown clay loam. In many places the solum is less than 20 inches thick. In some places the soil is only slightly or moderately eroded. In other places it is very severely eroded. In some areas the subsoil and underlying material have less clay. In a few areas the underlying material is stratified silt and fine sand. In places the slope is less than 12 or more than 20 percent.

Included with this soil in mapping are soils that formed in sand and gravel. Also included are small areas of the somewhat poorly drained Blount soils along small drainageways and the well drained Hennepin soils on steep breaks. Hennepin soils are less clayey than the Morley soil. Included soils make up 2 to 12 percent of the map unit.

The Morley soil has a moderate available water capacity. Permeability is slow. Runoff is rapid. The surface layer has a low organic matter content. This layer is firm, and tilth is poor.

Most areas of this soil are used for cultivated crops. Many are used for hay or pasture. A few are used as wildlife habitat.

Because of the hazard of further erosion, this soil is generally unsuited to corn, soybeans, and small grain (fig. 9). It is poorly suited to grasses and legumes for hay. It is fairly well suited to pasture. Orchardgrass and alfalfa grow well. Overgrazing or grazing when the soil is wet results in surface compaction, excessive runoff, and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to trees. Plant competition, the erosion hazard, and the equipment limitation are the main management concerns. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying. The slope limits the types of equipment that can be operated safely on this soil. Restricting the use of heavy equipment, constructing logging roads on the contour, and installing water bars help to control erosion.

Because of the slope, this soil is severely limited as a site for dwellings. The buildings should be designed so that they conform to the natural slope of the land. Land shaping and retaining walls also help to overcome the slope. Retaining as much of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion. Because of the slope and low strength, the soil is severely limited as a site for local roads and streets. Cutting and filling are needed. Also, the roads should be built on the contour if possible. Strengthening or replacing the base with better suited material improves the ability of the roads and streets to support vehicular traffic.

Because of the slope and the slow permeability, this soil is severely limited as a site for septic tank absorptior fields. Enlarging the absorption area and controlling the rate of flow from a holding tank improve the ability of the field to absorb the effluent. Installing the absorption field on the contour helps to overcome the slope.

The land capability classification is VIe. The woodland ordination symbol is 4R.

MxE3—Morley clay loam, 20 to 30 percent slopes, severely eroded. This deep, moderately steep and steep, well drained soil is on the breaks between uplands and bottom land and on the more rolling moraines. Areas are long and narrow and are 2 to 15 acres in size.

Typically, the surface layer is dark brown clay loam about 8 inches thick. In most areas, nearly all of the original darkened surface has been removed by erosion and tillage has mixed the rest with the upper part of the subsoil. The subsoil is about 12 inches of dark yellowish brown, firm clay and clay loam. The underlying material to a depth of 60 inches is yellowish brown clay loam. In many places the solum is less than 20 inches thick. In some places the soil is only slightly or moderately eroded. In other places it is very severely eroded. In some areas the subsoil and underlying material have less clay. In other areas the slope is less than 20 or more than 30 percent.

Included with this soil in mapping are areas of soils that formed in sand or gravel and small areas of the well drained Hennepin soils on the steeper breaks. Hennepin soils are less clayey than the Morley soil. Included soils make up 2 to 10 percent of the map unit.

The Morley soil has a moderate available water capacity. Permeability is slow. Runoff is very rapid. The surface layer has a low organic matter content. This layer is firm, and tilth is poor.

Most areas of this soil are used for cultivated crops. Many are used for hay or pasture. A few are used as wildlife habitat.

Figure 9.—Erosion in an unprotected area of Morley clay loam, 12 to 20 percent slopes, severely eroded.

Because of the hazard of further erosion, this soil is generally unsuited to corn, soybeans, small grain, and hay. It is poorly suited to pasture. Haying equipment cannot be operated safely on these slopes. Overgrazing or grazing when the soil is wet results in surface compaction, excessive runoff, and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to trees. Plant competition, the erosion hazard, and the equipment limitation are the main management concerns. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying. The slope limits the types of equipment that can be operated safely on this soil. Restricting the use of heavy equipment, constructing logging roads on the contour, and installing water bars help to control erosion.

Because of the slope, this soil is generally unsuitable as a site for dwellings and sanitary facilities. It is severely limited as a site for local roads because of the slope and low strength. The roads should be built on the contour. Cutting and filling may be needed. Strengthening or replacing the base with better suited material improves the ability of the roads and streets to support vehicular traffic. Areas disturbed during construction should be revegetated as soon as possible.

The land capability classification is VIIe. The woodland ordination symbol is 4R.

Mz—Muskego muck, clay loam substratum, drained. This nearly level, deep, very poorly drained soil is in deep depressions on till plains and moraines. Because of runoff from the higher adjacent slopes, it is ponded or saturated in late winter, in early spring, or after heavy rains. Areas are oval or irregular in shape and are 2 to 25 acres in size.

Typically, the surface tier is black muck about 6 inches thick. The subsurface tier is black and dark brown muck about 12 inches thick. The upper 34 inches of the underlying material is very dark grayish brown, dark olive gray, and olive gray, firm and friable coprogenous earth. The lower part to a depth of 60 inches is gray clay loam. In some areas the surface tier is high in content of mineral material. In a few areas the muck is less than 16 or more than 50 inches deep over the coprogenous earth. In places the soil is underlain by marl or by sandy clay loam to gravelly sand.

Included with this soil in mapping are undrained areas or areas where the drainage system has failed and marsh vegetation has become established. Also included are small areas of the very poorly drained, mineral Milford and Rensselaer soils near the edge of the depressions and on slight rises. Included soils make up 5 to 13 percent of the map unit.

The Muskego soil has a very high available water capacity. Permeability is slow. The water table is near or above the surface during winter and spring. Runoff is very slow or ponded. The surface layer has a very high organic matter content. This layer is very friable, and tilth is good.

Most areas of this soil are used for cultivated crops. Some are used as pasture. A few support marsh vegetation.

This soil is poorly suited to corn, soybeans, and small grain. Wetness and soil blowing are the main management concerns. Draining the soil is difficult because of poor drainage outlets. Because of the poor stability of the organic material, ditchbanks can cave in. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control soil blowing. Most herbicides are effective only if they are applied at a higher rate than is typical.

This soil is fairly well suited to grasses, such as reed canarygrass, for hay. It is well suited to pasture. Deep-rooted legumes, such as alfalfa, grow poorly because of the ponding and the high water table. Because of the poor stability of the muck, the use of haying equipment is restricted to dry periods.

This soil is poorly suited to trees. Seedling mortality, plant competition, the windthrow hazard, and the equipment limitation are management concerns. Replanting of seedlings is often necessary. Water-tolerant species should be selected for planting. Competing vegetation can be controlled by cutting, girdling, or spraying. Carefully thinning the stands or not thinning them at all and applying harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Ordinary crawler tractors and rubber-tired skidders cannot be operated on this soil. Heavy equipment should be used only when the ground is frozen.

Because of the ponding and low strength, this soil is generally unsuitable as a site for dwellings, local roads, and sanitary facilities. Extensive changes are needed to make the soil suitable for these uses.

The land capability classification is IVw. The woodland ordination symbol is 2W.

OmB—Ormas loamy fine sand, 0 to 4 percent slopes. This nearly level and gently sloping, deep, well drained soil is on river terraces and outwash plains. Areas are irregular in shape and are 2 to 15 acres in size.

Typically, the surface layer is dark brown loamy fine sand about 9 inches thick. The subsurface layer is light yellowish brown loamy fine sand about 12 inches thick. The subsoil is about 27 inches of dark brown, firm and friable sandy loam and gravelly sandy clay loam. The underlying material to a depth of 60 inches is brown, stratified sand and gravelly coarse sand. In some places the surface layer is darker. In other places the sandy surface soil is less than 20 inches thick. In some areas the solum is less than 45 inches thick. In other areas the seasonal high water table is within a depth of 6 feet. In a few places the soil is underlain by glacial till within a depth of 60 inches. In a few areas the subsoil has thin textural bands. In places the slope is more than 4 percent.

Included with this soil in mapping are a few areas of soils that have a gravelly surface layer. Also included are small areas of the very poorly drained Sebewa soils in small depressions. Included soils make up 2 to 6 percent of the map unit.

The Ormas soil has a moderate available water capacity. Permeability is moderately rapid in the upper part of the profile and very rapid in the underlying material. Runoff is slow. The surface layer has a moderately low organic matter content. This layer is loose, and tilth is good.

Most areas are used for cultivated crops. Some are used for hay or pasture. A few remain wooded. This soil is a probable source of sand and gravel.

This soil is fairly well suited to corn, soybeans, and small grain. Droughtiness and soil blowing are the main management concerns. Cover crops and a system of conservation tillage that leaves a protective amount of crop residue on the surface help to control soil blowing, reduce the evaporation rate, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay and pasture. Deep-rooted species should be selected for planting. Pasture rotation and deferment of grazing during dry periods help to keep the pasture in good condition.

This soil is fairly well suited to trees. Seedling mortality and plant competition are management concerns. Competing vegetation can be controlled by cutting, girdling, or spraying. Replanting of seedlings is often necessary. Drought-tolerant species should be selected for planting.

This soil is suitable as a site for dwellings and septic tank absorption fields. It is moderately limited as a site for local roads and streets because of frost action. Adequate side ditches and culverts help to prevent the damage caused by frost action.

The land capability classification is IIIs. The woodland ordination symbol is 4S.

OsA—Oshtemo sandy loam, 0 to 2 percent slopes. This nearly level, deep, well drained soil is on river terraces and outwash plains. Areas are irregular in shape and are 4 to 35 acres in size.

Typically, the surface layer is dark brown sandy loam about 10 inches thick. The subsoil is about 35 inches thick. The upper part is dark yellowish brown and dark brown, very friable and friable sandy loam and gravelly sandy loam. The lower part is dark yellowish brown, friable gravelly sandy clay loam. The underlying material to a depth of 60 inches is pale brown, stratified gravelly coarse sand and sand. In some areas the surface layer is darker. In other areas it is loamy sand or fine sand. In some places the solum is less than 40 inches thick. In other places the upper part of the subsoil has more clay. In a few areas the water table is within a depth of 6 feet. In places the slope is more than 2 percent.

Included with this soil in mapping are small areas of soils that have a gravelly surface layer. Also included are small areas of the very poorly drained Sebewa soils in small depressions. Included soils make up 2 to 8 percent of the map unit.

The Oshtemo soil has a moderate available water capacity. Permeability is moderately rapid in the solum and very rapid in the underlying material. Runoff is slow. The surface layer has a moderate organic matter content. This layer is very friable, and tilth is good.

Most areas are used for cultivated crops. Some are used for hay or pasture. A few remain wooded, but many of these are being cleared for cultivation. This soil is a probable source of sand and gravel.

This soil is fairly well suited to corn, soybeans, and small grain. Droughtiness and soil blowing are the main management concerns. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface reduce the evaporation rate, increase the rate of water infiltration, and help to control soil blowing. The soil is well suited to no-till farming.

This soil is well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay or pasture. Drought-tolerant species should be selected for planting. Pasture rotation and timely deferment of grazing help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. Unwanted trees and shrubs can be removed by cutting, girdling, or spraying.

This soil is suitable as a site for dwellings, local roads and streets, and septic tank absorption fields.

The land capability classification is IIIs. The woodland ordination symbol is 4A.

Pa—Palms muck, sandy substratum, undrained. This nearly level, deep, very poorly drained soil is in deep depressions on outwash plains, terraces, and bottom land. It is ponded in the spring and saturated throughout the year by springs and by runoff from the higher adjacent slopes. Areas are oval or irregular in shape and are 2 to 20 acres in size.

Typically, the surface tier is very dark brown muck about 5 inches thick. The subsurface tier is very dark brown and black muck about 22 inches thick. The underlying material extends to a depth of 60 inches. It is dark grayish brown and grayish brown, mottled clay loam, loam, and sandy loam in the upper part and gray sand in the lower part. In many places the surface layer is high in content of mineral material eroded from soils at higher elevations and deposited on top of the muck. In some areas the muck is less than 16 or more than 50 inches thick. In other areas the soil is underlain by sandy material, layers of marl, or coprogenous earth at a depth of less than 50 inches. In a few places it is not underlain by sandy material.

Included with this soil in mapping are small areas of the very poorly drained, mineral Mermill and Sloan soils on slight rises at the edges of the depressions and adjacent to the stream channels on bottom land. These soils make up 5 to 20 percent of the map unit.

The Palms soil has a very high available water capacity. Permeability is moderately slow to moderately rapid in the muck and loamy material and rapid in the sandy part of the underlying material. The water table is near or above the surface throughout the year. Runoff is very slow or ponded. The surface layer has a very high organic matter content. This layer is very friable, and tilth is good.

Inadequately drained areas are used as pasture. Undrained areas support marsh vegetation. Because of the ponding and the hazard of soil blowing, this soil is generally unsuited to corn, soybeans, and small grain. It is poorly suited to hay and is fairly well suited to pasture. Reed canarygrass grows well, but deep-rooted legumes, such as alfalfa, grow poorly because of the ponding and the high water table. The poor stability of the muck restricts the use of haying equipment.

This soil is poorly suited to trees. Seedling mortality, plant competition, the windthrow hazard, and the equipment limitation are management concerns. Replanting of seedlings is often necessary. Water-tolerant species should be selected for planting. Competing vegetation can be controlled by cutting, girdling, or spraying. Carefully thinning the stands or not thinning them at all and applying harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Ordinary crawler tractors and rubber-tired skidders cannot be operated on this soil. Most heavy equipment should be used only when the ground is frozen.

Because of the ponding and low strength, this soil is generally unsuitable as a site for dwellings, local roads and streets, and septic tank absorption fields. Extensive changes are needed to make the soil suitable for these uses.

The land capability classification is VIw. The woodland ordination symbol is 4W.

Pb—Palms muck, sandy substratum, drained. This nearly level, deep, very poorly drained soil is in deep depressions on outwash plains, terraces, and bottom land. Because of runoff from the higher adjacent slopes, it is ponded or saturated in late winter and early spring. Areas are oval or irregular in shape and are 2 to 15 acres in size.

Typically, the surface tier is black muck about 9 inches thick. The subsurface tier also is black muck. It is about 14 inches thick. The upper part of the underlying material is very dark gray, yellowish brown, and dark gray silty clay loam and silt loam. The lower part to a depth of 60 inches is gray and dark gray loamy fine sand and fine sand. In many places the surface tier is high in content of mineral material. In a few areas the muck is less than 16 or more than 50 inches thick. In some areas it is underlain by sandy material, layers of marl, or coprogenous earth within a depth of 50 inches. In a few places the soil is not underlain by sandy material.

Included with this soil in mapping are undrained areas or areas where the drainage system has failed and marsh vegetation has become established. Also included are small areas of the very poorly drained Mermill and Sloan soils on slight rises at the edges of the depressions or adjacent to the stream channels on bottom land. These soils formed in mineral material. Included soils make up 5 to 15 percent of the map unit.

The Palms soil has a very high available water capacity. Permeability is moderately slow to moderately rapid in the muck and in the upper part of the underlying material. It is rapid in the sandy part of the underlying material. The water table is near or above the surface during winter and spring. Runoff is very slow or ponded. The surface layer has a very high organic matter content. This layer is very friable, and tilth is good.

Most areas of this soil are used for cultivated crops. Some support marsh vegetation. A few are used as pasture.

This soil is fairly well suited to corn, soybeans, and small grain. Wetness and soil blowing are the main management concerns. Crops grow poorly in undrained areas. Draining the soil is difficult because of poor drainage outlets. Because of the poor stability of the organic material, ditchbanks can cave in. If subsurface drains are installed below a depth of 4 feet, fine sand can flow into the drains and clog them. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control soil blowing. Most herbicides are effective only if they are applied at a higher rate than is typical.

This soil is well suited to grasses, such as reed canarygrass, for hay or pasture. Deep-rooted legumes, such as alfalfa, grow poorly because of the ponding or the high water table. Because of the poor stability of the muck, the use of haying equipment is restricted to dry periods.

This soil is poorly suited to trees. Seedling mortality, plant competition, the windthrow hazard, and the equipment limitation are management concerns. Replanting of seedlings is often necessary. Water-tolerant species should be selected for planting. Competing vegetation can be controlled by cutting, girdling, or spraying. Carefully thinning the stands or not thinning them at all and applying harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Ordinary crawler tractors and rubber-tired skidders cannot be operated on this soil. Heavy equipment should be used only when the ground is frozen.

Because of the ponding and low strength, this soil is generally unsuitable as a site for dwellings, local roads, and septic tank absorption fields. Extensive changes are needed to make the soil suitable for these uses.

The land capability classification is IIIw. The woodland ordination symbol is 4W.

Pw—Pewamo silty clay loam. This nearly level, deep, very poorly drained soil is in depressions and drainageways on till plains and moraines. It is ponded by runoff from the higher adjacent slopes (fig. 10). Areas are irregular in shape and are 2 to 50 acres in size.

Typically, the surface layer is very dark gray silty clay loam about 11 inches thick. The subsoil is about 36 inches thick. It is mottled and firm. The upper part is dark gray clay, and the lower part is gray silty clay loam and clay loam. The underlying material to a depth of 60 inches is yellowish brown, mottled clay loam. In some places the dark surface soil is less than 10 inches thick. In other places the surface layer is lighter colored. In some areas, the solum is thin and the subsoil shows

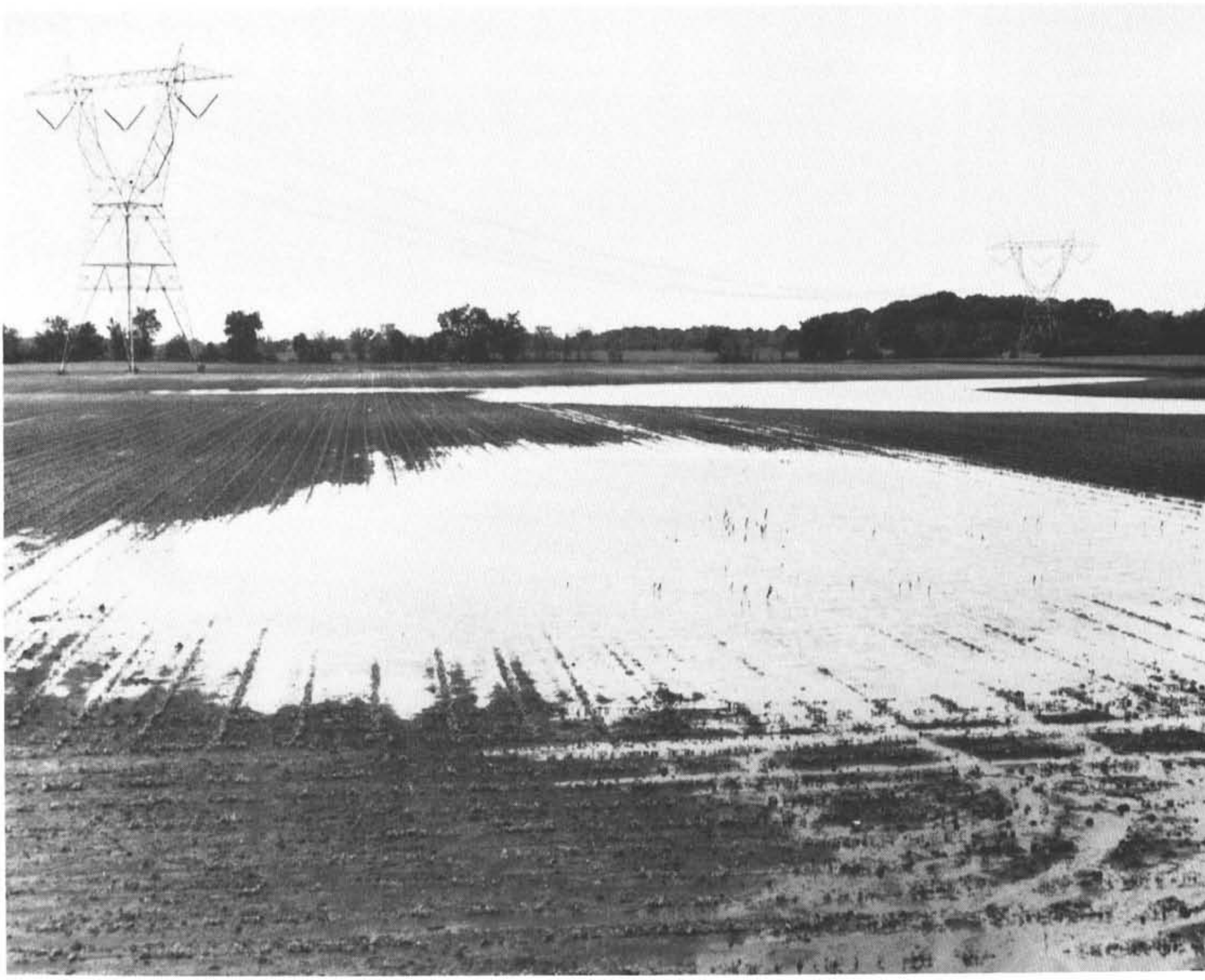

Figure 10.—Ponding in an area of Pewamo silty clay loam.

little evidence of profile development. In other areas the solum formed in a mantle of lacustrine material. In a few places the underlying material has less clay. In some places the upper part of the solum has less clay. In other places strata of loamy and sandy material overlie the glacial till. In some areas the slope is more than 2 percent.

Included with this soil in mapping are undrained areas of woodland, pasture, or deep depressions. These areas stay wet most of the year. Also included are small areas of the somewhat poorly drained Blount and Haskins and moderately well drained Glynwood soils on slight rises and the very poorly drained Boots and Houghton soils in the deeper depressions. Boots and Houghton soils are mucky. Included soils make up 4 to 12 percent of the map unit.

The Pewamo soil has a high available water capacity. Permeability is moderately slow. The water table is near or above the surface during winter and early spring. Runoff is very slow or ponded. The surface layer has a high organic matter content. This layer is friable, and tilth is fair.

Most areas of this soil are used for cultivated crops. Some are used for hay or pasture. A few remain wooded, but some of these are being cleared and drained for cultivation.

If drained, this soil is well suited to corn, soybeans, and small grain. If drained and properly managed, it can be intensively row cropped. Wetness and ponding are the main management concerns. Crops grow poorly in undrained areas. Shallow surface drains and subsurface drains can remove excess water if adequate outlets are available. Because of the content of clay in the surface layer, preparing a suitable seedbed is difficult in some areas. If the soil is plowed when wet, it becomes cloddy as it dries. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface minimize crusting, improve tilth, and increase the rate of water infiltration. The soil is well suited to fall plowing.

This soil is well suited to grasses, such as orchardgrass, and legumes, such as red clover, for hay or pasture. Deep-rooted legumes, such as alfalfa, grow poorly in inadequately drained areas because of the high water table and the temporary ponding. Even if subsurface drains are installed, the legumes can be damaged during brief periods of ponding. Overgrazing or grazing when the soil is wet results in surface compaction and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is fairly well suited to trees. Seedling mortality, the windthrow hazard, the equipment limitation, and plant competition are management concerns. Replanting of seedlings is often necessary. Water-tolerant species should be selected for planting. Competing vegetation can be controlled by cutting, girdling, or spraying. Carefully thinning the stands or not thinning them at all and applying harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Harvesting activities are restricted to dry periods or to periods when the ground is frozen.

Because of the ponding, this soil is generally unsuitable as a site for dwellings and sanitary facilities. It is severely limited as a site for local roads because of the ponding, frost action, and low strength. Constructing the roads on raised, well compacted, better suited fill material and providing adequate side ditches and culverts improve the ability of the roads to support vehicular traffic and help to prevent the road damage caused by ponding and frost action.

The land capability classification is IIw. The woodland ordination symbol is 4W.

Px—Pits, gravel. This nearly level to steep, well drained map unit occurs as excavations on uplands, terraces, outwash plains, and bottom land. Areas are irregular in shape and are 1 to 20 acres in size.

Typically, the upper soil material has been removed and the sand and gravel exposed. In places soil material has been washed into the pits and supports a sparse cover of vegetation.

Included in this unit in mapping are small areas where the overburden has been piled up and supports a cover of vegetation and some small pits in upland areas where all of the gravel has been removed and glacial till is exposed. Also included are areas where water is in the lowest part of the pit.

Most areas support very little vegetation. Major land reclamation is needed before a plant cover can be established.

No land capability classification or woodland ordination symbol is assigned.

RcA—Rawson sandy loam, 0 to 2 percent slopes. This nearly level, deep, moderately well drained soil is on till plains and moraines. Areas are irregular in shape and are 3 to 15 acres in size.

Typically, the surface layer is dark brown sandy loam about 9 inches thick. The subsoil is about 31 inches thick. The upper part is dark yellowish brown and brown, friable sandy clay loam and sandy loam. The lower part is dark yellowish brown, dark brown, and yellowish brown, mottled, firm clay and clay loam. The underlying material to a depth of 60 inches is yellowish brown, mottled, firm clay loam. In some places the surface layer is loamy fine sand. In other places the upper part of the subsoil has more sand and less clay. In some areas less than 20 inches of loamy outwash overlies the till. In a few areas the content of gravel in the upper part of the subsoil is as much as 25 percent. In some places the solum is more than 48 inches thick. In many places the underlying material has less clay. In a few areas the soil is well drained. In places the slope is more than 2 percent.

Included with this soil in mapping are small areas where the surface layer is gravelly or stony and areas of soils that formed entirely in loamy, sandy, or gravelly deposits that are thicker than those of the Rawson soil. Also included are small areas of the somewhat poorly drained Haskins soils at the lower elevations, the very poorly drained Mermill soils in depressions and narrow drainageways, and the well drained, sandy Spinks soils on hills and ridgetops. Included soils make up 5 to 15 percent of the map unit.

The Rawson soil has a moderate available water capacity. Permeability is moderate in the upper part of the profile and slow in the lower part. The water table is at a depth of 2.5 to 4.0 feet during winter and early spring. Runoff is slow. The surface layer has a moderate organic matter content. This layer is very friable, and tilth is good.

Most areas of this soil are used for cultivated crops. A few are used for hay and pasture. A few remain wooded, but some of these are being cleared for cultivation.

This soil is well suited to corn, soybeans, and small grain. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface reduce the evaporation rate, minimize crusting, help to control soil blowing, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay or pasture. Overgrazing results in surface compaction and poor tilth. Pasture rotation and timely deferment of grazing help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying.

This soil is suitable as a site for dwellings without basements. It is moderately limited as a site for dwellings with basements because of the wetness and the shrink-swell potential. Subsurface drains help to lower the water table. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. Because of frost action, the soil is moderately limited as a site for local roads and streets. Replacing or covering the upper soil layers with suitable base material and providing adequate ditches and culverts help to prevent the road damage caused by frost action.

Because of the wetness and the slow permeability, this soil is severely limited as a site for septic tank absorption fields. Enlarging the absorption field helps to compensate for the restricted permeability. Subsurface interceptor drains around the perimeter of the absorption field help to remove excess water.

The land capability classification is I. The woodland ordination symbol is 4A.

RcB—Rawson sandy loam, 2 to 6 percent slopes. This gently sloping, deep, moderately well drained soil is on till plains and moraines. Areas are irregular in shape and are 3 to 25 acres in size.

Typically, the surface layer is dark grayish brown sandy loam about 9 inches thick. The subsoil is about 29 inches thick. The upper part is yellowish brown, dark brown, and dark yellowish brown, friable and very friable sandy loam and sandy clay loam. The lower part is yellowish brown, mottled, firm clay and clay loam. The underlying material to a depth of 60 inches is brown, mottled clay loam. In some places the mantle of loamy outwash is less than 20 inches thick. In other places the surface layer is loamy sand. In a few areas the upper part of the subsoil has less clay and has a gravel content of as much as 25 percent. In some areas the underlying material has less clay. In other areas the solum is more than 48 inches thick. In some places the soil is moderately eroded. In other places it is well drained. In some areas the slope is less than 2 or more than 6 percent.

Included with this soil in mapping are small areas of severely eroded soils that have a surface layer of sandy clay loam, small areas where the slope is more than 12 percent, and areas of soils that formed entirely in loamy, sandy, or gravelly deposits that are thicker than those of the Rawson soil. Also included are small areas of the somewhat poorly drained Haskins soils in narrow drainageways and on foot slopes, the very poorly drained Mermill soil in depressions and narrow drainageways, and the well drained, sandy Spinks soils on hills and ridgetops. Included soils make up 5 to 15 percent of the map unit.

The Rawson soil has a moderate available water capacity. Permeability is moderate in the upper part of the profile and slow in the lower part. The water table is at a depth of 2.5 to 4.0 feet during winter and early spring. Runoff is medium. The surface layer has a moderate organic matter content. This layer is very friable, and tilth is good.

Most areas of this soil are used for cultivated crops. Some are used for hay or pasture. A few remain wooded, but some of these are being cleared for cultivation.

This soil is well suited to corn, soybeans, and small grain. Erosion and soil blowing are the main management concerns. A few cobbles and stones on or near the surface can hinder fieldwork. A cropping system that includes grasses and legumes, diversions, grassed waterways, and grade stabilization structures help to control erosion and runoff. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control erosion and soil blowing, minimize crusting, improve tilth, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay or pasture. Overgrazing results in surface compaction and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying.

This soil is suitable as a site for dwellings without basements. It is moderately limited as a site for dwellings with basements because of the wetness and the shrink-swell potential. Subsurface drains help to lower the water table. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. Because of frost action, the soil is moderately limited as a site for local roads and streets. Strengthening or replacing the base with better suited material and providing adequate ditches and culverts help to prevent the road damage caused by frost action.

Because of the wetness and the slow permeability, this soil is severely limited as a site for septic tank absorption fields. Enlarging the absorption field helps to compensate for the restricted permeability. Subsurface interceptor drains around the perimeter of the absorption field help to remove excess water.

The land capability classification is IIe. The woodland ordination symbol is 4A.

RcC—Rawson sandy loam, 6 to 12 percent slopes. This moderately sloping, deep, moderately well drained soil is on till plains and moraines. Areas are irregular in shape and are 3 to 20 acres in size.

Typically, the surface layer is dark brown sandy loam about 9 inches thick. The subsoil is about 27 inches thick. The upper part is dark brown, friable clay loam and sandy clay loam. The lower part is yellowish brown and brown, mottled, firm clay and clay loam. The underlying material to a depth of 60 inches is brown clay loam. In some places the surface layer is loamy fine sand. In other places the mantle of loamy outwash is less than 20 inches thick. In a few places the upper part of the subsoil has less clay and has a gravel content of as much as 25 percent. In some areas the underlying material has less clay. In other areas the soil is moderately eroded. In some places the slope is less than 6 or more than 12 percent. In other places the soil is well drained.

Included with this soil in mapping are small areas of severely eroded soils, a few short slopes of more than 18 percent, and areas of soils that formed entirely in loamy, sandy, or gravelly deposits that are thicker than those of the Rawson soil. Also included are small areas of the somewhat poorly drained Haskins soils in narrow drainageways and on foot slopes and the well drained, sandy Spinks soils on the ridgetops. Included soils make up 4 to 12 percent of the map unit.

The Rawson soil has a moderate available water capacity. Permeability is moderate in the upper part of the profile and slow in the lower part. The water table is at a depth of 2.5 to 4.0 feet during winter and early spring. Runoff is medium. The surface layer has a moderate organic matter content. This layer is very friable, and tilth is good.

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

This soil is fairly well suited to corn, soybeans, and small grain. Erosion and soil blowing are the main management concerns. A few cobbles and stones on or near the surface can hinder fieldwork. A cropping system that includes grasses and legumes, diversions, grassed waterways, and grade stabilization structures help to control erosion and runoff. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control erosion and soil blowing, minimize crusting, improve tilth, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay or pasture. Overgrazing results in surface compaction, poor tilth, and excessive runoff. Pasture rotation and timely deferment of grazing help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying.

Because of the wetness, the slope, and shrink-swell potential, this soil is moderately limited as a site for dwellings. Subsurface drains help to lower the water table. Land shaping and installing retaining walls help to overcome the slope. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. Disturbing as little of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion.

Because of the slope and the potential for frost action, this soil is moderately limited as a site for local roads and streets. Constructing the roads on the contour and land shaping help to overcome the slope. Replacing or covering the upper soil layers with suitable base material and providing adequate ditches and culverts help to prevent the damage caused by frost action.

Because of the wetness and the slow permeability, this soil is severely limited as a site for septic tank absorption fields. Enlarging the absorption area and controlling the rate of flow from a holding tank improve the ability of the field to absorb the effluent. Subsurface interceptor drains around the absorption field help to remove excess water.

The land capability classification is IIIe. The woodland ordination symbol is 4A.

Re—Rensselaer loam. This nearly level, deep, very poorly drained soil is in depressions and drainageways on outwash plains and terraces. It is ponded by runoff from the higher adjacent slopes. Areas are irregular in shape and are 3 to 20 acres in size.

Typically, the surface layer is black loam about 10 inches thick. The subsurface layer is about 4 inches of very dark gray loam. The subsoil is about 34 inches thick. The upper part is dark gray and grayish brown, mottled, friable and firm sandy clay loam and clay loam. The lower part is grayish brown, mottled, friable and very friable sandy loam and loamy sand. The underlying material to a depth of 60 inches is grayish brown and gray, mottled, stratified sandy loam, loamy sand, and sand. In a few places the dark surface soil is less than 10 inches thick. In some places the soil is underlain by glacial till. In other places the upper part of the solum formed in a mantle of clayey lacustrine material. In some areas the surface layer is lighter colored. In other areas the subsoil and underlying material have more gravel.

Included with this soil in mapping are undrained areas of woodland, pasture, or deep depressions. These areas stay wet most of the year. Also included are areas of the very poorly drained Adrian, Houghton, Martisco, and Muskego soils in deep depressions; the somewhat poorly drained Whitaker soils on slight rises; and the well drained Martinsville soils on the higher, more sloping parts of the landscape. Adrian, Houghton, and Martisco soils are mucky. Included soils make up 5 to 15 percent of the map unit.

The Rensselaer soil has a high available water capacity. Permeability is moderate. The water table is near or above the surface during winter and early spring. Runoff is very slow or ponded. The surface layer has a high organic matter content. This layer is friable, and tilth is good.

Most areas of this soil are used for cultivated crops. Some are used for hay or pasture. A few remain wooded, but some of these are being cleared and drained for cultivation.

If drained, this soil is well suited to corn, soybeans, and small grain. If drained and properly managed, it can be intensively row cropped. Wetness and ponding are the major management concerns. Shallow surface drains and subsurface drains can remove excess water if adequate outlets are available. If subsurface drains are installed, fine sand can flow into the drains and clog them. In some areas preparing a suitable seedbed is difficult. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface minimize crusting, improve tilth, and increase the rate of water infiltration. The soil is well suited to fall plowing.

If drained, this soil is well suited to grasses, such as orchardgrass and bromegrass, and legumes, such as ladino clover, for hay or pasture. In undrained areas it is well suited to reed canarygrass. Deep-rooted legumes, such as alfalfa, grow poorly in inadequately drained areas because of the high water table and the temporary ponding. Even if subsurface drains are installed, the legumes can be damaged during brief periods of ponding. Overgrazing or grazing when the soil is wet results in surface compaction and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is fairly well suited to trees. Seedling mortality, the windthrow hazard, the equipment limitation, and plant competition are management concerns. Replanting of seedlings is often necessary. Water-tolerant species should be selected for planting. Competing vegetation can be controlled by cutting, girdling, or spraying. Carefully thinning the stands or not thinning them at all and applying harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Harvesting activities are restricted to dry periods or to periods when the ground is frozen.

Because of the ponding, this soil is generally unsuitable as a site for dwellings and sanitary facilities. It is severely limited as a site for local roads because of the ponding, frost action, and low strength. Constructing the roads on raised, well compacted fill material, strengthening or replacing the base with better suited material, and providing adequate ditches and culverts minimize the road damage caused by ponding, frost action, and low strength.

The land capability classification is IIw. The woodland ordination symbol is 4W.

RhB—Riddles sandy loam, 1 to 6 percent slopes. This gently sloping, deep, well drained soil is on moraines. Areas are irregular in shape and are 3 to 30 acres in size.

Typically, the surface layer is dark brown sandy loam about 10 inches thick. The subsurface layer is about 3 inches of yellowish brown sandy loam. The subsoil is about 35 inches of dark yellowish brown and yellowish brown, firm clay loam and loam. The underlying material to a depth of 60 inches is brown loam. In places the content of gravel in some layers in the subsoil is as much as 15 percent. In some areas strata of sand and silt are between the subsoil and the underlying till. In other areas the solum is less than 40 inches thick. In some places the underlying material has more clay. In other places the slope is less than 1 or more than 6 percent. In some areas the soil is moderately eroded.

Included with this soil in mapping are small areas of severely eroded soils that have a surface layer of clay loam. Also included are small breaks where the slope is more than 12 percent and small areas of the somewhat poorly drained Crosier and very poorly drained Brookston soils on foot slopes, along narrow drainageways, and in small depressions. Included soils make up 4 to 12 percent of the map unit.

The Riddles soil has a high available water capacity. Permeability is moderate. Runoff is medium. The surface layer has a moderate organic matter content. This layer is friable, and tilth is good.

Most areas of this soil are used for cultivated crops. Some are used for hay or pasture. A few remain wooded.

This soil is well suited to corn, soybeans, and small grain. Erosion and soil blowing are the main management concerns. A few stones on or near the surface can hinder fieldwork. A cropping system that includes grasses and legumes, diversions, contour farming, grassed waterways, and grade stabilization structures help to control erosion and runoff. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control erosion and soil blowing, minimize crusting, improve tilth, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay or pasture. Overgrazing or grazing when the soil is wet results in surface compaction, excessive runoff, and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying.

Because of the shrink-swell potential, this soil is moderately limited as a site for dwellings. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. Because of frost action and low strength, the soil is moderately limited as a site for local roads and streets. Strengthening or replacing the base with better suited material improves the ability of the roads and streets to support vehicular traffic. Adequate ditches and culverts help to prevent the road damage caused by frost action.

Because of the moderate permeability, this soil is moderately limited as a site for septic tank absorption fields. Enlarging the absorption fields helps to compensate for the restricted permeability.

The land capability classification is IIe. The woodland ordination symbol is 5A.

RhC—Riddles sandy loam, 6 to 12 percent slopes. This moderately sloping, deep, well drained soil is on moraines. Areas are irregular in shape and are 3 to 10 acres in size.

Typically, the surface layer is dark brown sandy loam about 8 inches thick. The subsoil is about 35 inches of dark yellowish brown and brown, firm clay loam and loam. The underlying material to a depth of 60 inches is brown loam. In some areas the solum is less than 40 inches thick. In a few areas the content of gravel in the subsoil is as much as 15 percent. In some places strata of sand and silt are between the subsoil and the underlying material. In other places the underlying material has more clay. In some areas the slope is less than 6 or more than 12 percent. In other areas the soil is moderately eroded.

Included with this soil in mapping are small areas of severely eroded soils that have a surface layer of clay loam. Also included are small breaks where the slope is more than 18 percent and small areas of the somewhat poorly drained Crosier soils on foot slopes and the very poorly drained Brookston soils along small drainageways. Included soils make up 2 to 10 percent of the map unit.

The Riddles soil has a high available water capacity. Permeability is moderate. Runoff is medium. The surface layer has a moderate organic matter content. This layer is friable, and tilth is good.

Most areas of this soil are used for cultivated crops. Many are used for hay or pasture. A few remain wooded.

This soil is fairly well suited to corn, soybeans, and small grain. Erosion and soil blowing are the main management concerns. A few stones on or near the surface can hinder fieldwork. A cropping system that includes small grain and meadow crops, diversions, contour farming, grassed waterways, and grade stabilization structures help to control erosion and runoff. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control erosion and soil blowing, minimize crusting, improve tilth, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay or pasture. Overgrazing or grazing when the soil is wet results in surface compaction, excessive runoff, and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying.

Because of the slope and the shrink-swell potential, this soil is moderately limited as a site for dwellings. The buildings should be designed so that they conform to the natural slope of the land. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. Disturbing as little of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion.

Because of the slope, frost action, and low strength, this soil is moderately limited as a site for local roads and streets. Constructing the roads and streets on the contour and land shaping help to overcome the slope. Strengthening or replacing the base with better suited material improves the ability of the roads and streets to support vehicular traffic. Adequate ditches and culverts help to prevent the road damage caused by frost action.

Because of the moderate permeability and the slope, this soil is moderately limited as a site for septic tank absorption fields. Enlarging the absorption field helps to compensate for the restricted permeability. Installing the absorption field on the contour helps to ensure an even distribution of the effluent.

The land capability classification is IIIe. The woodland ordination symbol is 5A.

Sa—Saranac silty clay loam, sandy substratum, frequently flooded. This nearly level, deep, very poorly drained soil is on bottom land and in small glacial lakebeds. It is frequently flooded by stream overflow and is ponded by runoff from the higher adjacent slopes. Areas are irregular in shape and are 3 to 80 acres in size.

Typically, the surface layer is very dark gray silty clay loam about 8 inches thick. The subsurface layer also is very dark gray silty clay loam. It is about 3 inches thick. The subsoil is about 35 inches of very dark gray, dark gray, gray, and yellowish brown, mottled, firm silty clay and clay. The underlying material to a depth of 60 inches is dark gray and gray, mottled, stratified sandy clay loam, sandy loam, fine sand, and sand. In some places the surface layer is silty clay. In other places the dark surface soil is less than 10 inches thick. In some areas the surface layer is lighter colored. In other areas the underlying material is silty clay loam or silty clay. In some places the glacial till is within a depth of 48 inches. In other places the soil is only occasionally flooded. In some areas the upper part of the solum has more sand and less clay.

Included with this soil in mapping are small undrained areas that stay wet most of the year. The soils in these areas have a thin surface layer of muck. Also included are small areas of the poorly drained Houghton and Wallkill soils in deep depressions and the somewhat poorly drained Shoals soils along stream channels. Houghton and Wallkill soils are more mucky than the Saranac soil. Included soils make up 2 to 8 percent of the map unit.

The Saranac soil has a high available water capacity. Permeability is moderately slow in the solum and moderately rapid in the underlying material. The water table is near or above the surface during the winter and spring. Runoff is very slow or ponded. The surface layer has a high organic matter content. This layer is firm, and tilth is fair.

Most large areas of bottom land are used for cultivated crops. The small areas of bottom land are used as pasture or woodland. This soil is a probable source of sand and gravel.

If drained, this soil is fairly well suited to corn, soybeans, and small grain. If drained and properly managed, it can be intensively row cropped. Wetness and flooding are the main management concerns. Crops grow poorly in undrained areas. Subsurface drains can remove excess water if adequate outlets are available. These outlets are not available in some areas. Drains installed below a depth of 3 feet can be clogged by fine sand. Levees help to protect the soil against flooding. Preparing a suitable seedbed is difficult. If it has been plowed when wet, the soil becomes cloddy as it dries. Breaking up the hard clods is difficult. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface minimize crusting, improve tilth, and increase the rate of water infiltration.

This soil is well suited to grasses, such as reed canarygrass, and some legumes, such as ladino clover, for hay or pasture. Deep-rooted legumes, such as alfalfa, grow poorly in inadequately drained areas and in areas that are not protected against flooding. Even if subsurface drains are installed, the legumes can be damaged during brief periods of flooding or ponding. Overgrazing or grazing when the soil is wet results in surface compaction and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is fairly well suited to trees. Seedling mortality, the windthrow hazard, the equipment limitation, and plant competition are management concerns. Replanting of seedlings is often necessary. Water-tolerant species should be selected for planting. Competing vegetation can be controlled by cutting, girdling, or spraying. Carefully thinning the stands or not thinning them at all and applying harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Harvesting activities are restricted to dry periods or to periods when the ground is frozen.

Because of the ponding and the flooding, this soil is generally unsuitable as a site for dwellings and sanitary facilities. It is severely limited as a site for local roads because of the ponding, the flooding, and low strength. Constructing the roads on raised, well compacted fill material and providing adequate ditches and culverts help to prevent the road damage caused by floodwater and ponding and improve the ability of the roads to support vehicular traffic.

The land capability classification is IIIw. The woodland ordination is 4W.

Se—Sebewa loam. This nearly level, deep, very poorly drained soil is in depressions and narrow drainageways on outwash plains and river terraces. It is often ponded by runoff from the higher adjacent slopes. Areas are irregular in shape and are 3 to 20 acres in size.

Typically, the surface layer is very dark gray loam about 10 inches thick. The subsurface layer is about 3 inches of black loam. The subsoil is about 20 inches of dark gray, very dark gray, and dark grayish brown, mottled, firm to very friable clay loam, sandy clay loam, and gravelly sandy loam. The underlying material to a depth of 60 inches is gray, stratified gravelly coarse sand and sand. In a few places the surface layer is gravelly sandy loam and is lighter colored. In some places the dark surface soil is less than 10 inches thick. In other places the depth to sand and gravel is more than 50 inches. In some areas the content of clay does not increase between the surface soil and the subsoil. In other areas the upper part of the solum formed in a mantle of clayey lacustrine material. In a few places the underlying material has no gravel. In some areas glacial till is within a depth of 60 inches.

Included with this soil in mapping are small undrained areas of woodland, pasture, or deep depressions. These areas stay wet most of the year. Also included are small areas of the somewhat poorly drained Homer soils on slight rises and the well drained Boyer, Kalamazoo, Ormas, and Oshtemo soils on the higher slopes. Included soils make up 2 to 10 percent of the map unit.

The Sebewa soil has a moderate available water capacity. Permeability is moderate in the solum and rapid in the underlying material. The water table is near or above the surface during winter and early spring. Runoff is very slow or ponded. The surface layer has a high organic matter content. This layer is friable, and tilth is good.

Most areas are used for cultivated crops. Some are used for hay or pasture. A few remain wooded, but some of these are being cleared and drained for cultivation. This soil is a probable source of sand and gravel.

If drained, this soil is well suited to corn, soybeans, and small grain. If drained and well managed, it can be intensively row cropped. Wetness and ponding are the main management concerns. Shallow surface drains and subsurface drains can remove excess water if adequate outlets are available. If the soil is overdrained, drought is a hazard. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface minimize crusting, improve tilth, and increase the rate of water infiltration. The soil is well suited to fall plowing.

This soil is well suited to grasses, such as orchardgrass, and some legumes, such as ladino clover, for hay or pasture. Deep-rooted legumes, such as alfalfa, grow poorly in inadequately drained areas because of the high water table and the temporary ponding. Even if subsurface drains are installed, the legumes can be damaged during brief periods of ponding. Overgrazing or grazing when the soil is wet results in surface compaction and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is fairly well suited to trees. Seedling mortality, the windthrow hazard, the equipment limitation, and plant competition are management concerns. Replanting of seedlings is often necessary. Water-tolerant species should be selected for planting. Competing vegetation can be controlled by cutting, girdling, or spraying. Carefully thinning the stands or not thinning them at all and applying harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Harvesting activities are restricted to dry periods or to periods when the ground is frozen.

Because of the ponding, this soil is generally unsuitable as a site for dwellings and sanitary facilities. It is severely limited as a site for local roads because of the ponding and frost action. Constructing the roads on raised, well compacted fill material and providing adequate ditches and culverts help to prevent the damage caused by ponding and frost action.

The land capability classification is IIw. The woodland ordination symbol is 4W.

SfB—Seward loamy fine sand, 2 to 6 percent slopes. This gently sloping, deep, moderately well drained soil is on moraines and till plains. Areas are irregular in shape and are 3 to 15 acres in size.

Typically, the surface layer is dark grayish brown loamy fine sand about 10 inches thick. The subsurface layer is about 20 inches of brown and pale brown fine sand, sand, and loamy sand. The subsoil is about 9 inches of dark yellowish brown and yellowish brown, mottled, firm sandy clay loam and clay loam. The underlying material to a depth of 60 inches is brown, mottled clay loam. In some places the sandy material is less than 20 or more than 40 inches thick. In other places the solum is more than 48 inches thick. In a few places strata of sand and gravel are between the subsoil and the underlying glacial till. In some areas the slope is less than 2 or more than 6 percent. In other areas the soil is well drained.

Included with this soil in mapping are small areas of the well drained Morley soils on side slopes. These soils make up 2 to 12 percent of the map unit.

The Seward soil has a moderate available water capacity. Permeability is rapid in the upper part of the profile and slow in the lower part. The water table is at a depth of 3 to 6 feet during winter and early spring. Runoff is slow. The surface layer has a moderately low organic matter content. This layer is very friable, and tilth is good.

Most areas of this soil are used for cultivated crops. Some are used for hay or pasture. A few remain wooded.

This soil is well suited to corn, soybeans, and small grain. Drought and soil blowing are the main management concerns. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control soil blowing, reduce the evaporation rate, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay or pasture. Pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the pasture in good condition.

This soil is well suited to trees. Seedling mortality and plant competition are the main management concerns. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying. Replanting is often necessary.

This soil is suitable as a site for dwellings without basements. It is severely limited as a site for dwellings with basements because of the shrink-swell potential in the underlying material. Strengthening footings, foundations, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. Because of frost action, the soil is moderately limited as a site for local roads and streets. Strengthening or replacing the base with better suited material helps to prevent the road damage caused by frost action. Disturbing as little of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion.

Because of the wetness and the slow permeability, this soil is severely limited as a site for septic tank absorption fields. Enlarging the absorption field helps to compensate for the restricted permeability. Installing subsurface interceptor drains around the absorption field helps to remove excess water.

The land capability classification is IIe. The woodland ordination symbol is 4S.

SfC—Seward loamy fine sand, 6 to 15 percent slopes. This moderately sloping, deep, moderately well drained soil is on moraines and till plains. Areas are irregular in shape and are 3 to 15 acres in size.

Typically, the surface layer is dark brown loamy fine sand about 10 inches thick. The subsurface layer is about 15 inches of pale brown and brown fine sand and loamy fine sand. The subsoil is about 10 inches of dark brown and yellowish brown, mottled, firm sandy clay loam and clay loam. The underlying material to a depth of 60 inches is brown, mottled clay loam. In some places the sandy material is less than 20 or more than 40 inches thick. In other places the solum is more than 48 inches thick. In a few places strata of sand and gravel are between the subsoil and the underlying glacial till. In some areas the slope is less than 6 or more than 15 percent.

Included with this soil in mapping are small areas of the well drained Morley soils on side slopes. These soils make up 4 to 12 percent of the map unit.

The Seward soil has a moderate available water capacity. Permeability is rapid in the upper part of the profile and slow in the lower part. The water table is at a depth of 3 to 6 feet during winter and early spring. Runoff is medium. The surface layer has a moderately low organic matter content. This layer is very friable, and tilth is good.

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

This soil is fairly well suited to corn, soybeans, and small grain. Erosion, soil blowing, and drought are the main management concerns. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control erosion and soil blowing, reduce the evaporation rate, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay or pasture. Pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the pasture in good condition.

This soil is well suited to trees. Seedling mortality and plant competition are the main management concerns. Replanting of seedlings is often necessary. Competing vegetation can be controlled by cutting, girdling, or spraying.

Because of the slope, this soil is moderately limited as a site for dwellings without basements. It is severely limited as a site for dwellings with basements because of the shrink-swell potential. The buildings should be designed so that they conform to the natural slope of the land. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. Retaining as much of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion.

Because of the slope and the potential for frost action, this soil is moderately limited as a site for local roads and streets. Constructing the roads and streets on the contour and land shaping help to overcome the slope. Strengthening or replacing the base with better suited material and providing adequate ditches and culverts minimize the damage caused by frost action.

Because of the wetness and the slow permeability, this soil is severely limited as a site for septic tank absorption fields. Enlarging the absorption field helps to compensate for the restricted permeability. Subsurface interceptor drains around the absorption field help to lower the water table. Installing the absorption field on the contour helps to ensure an even distribution of the effluent.

The land capability classification is IIIe. The woodland ordination symbol is 4S.

Sh—Shoals silt loam, sandy substratum, frequently flooded. This nearly level, deep, somewhat poorly drained soil is on bottom land. It is flooded mainly in early spring. Areas are long and narrow and are 3 to 50 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 9 inches thick. The subsurface layer also is dark grayish brown silt loam. It is about 5 inches thick. The upper part of the underlying material is dark gray and yellowish brown, mottled, friable loam and sandy loam. The lower part to a depth of 60 inches is grayish brown, mottled, stratified sand and gravelly coarse sand. In some places sand and gravelly coarse sand are within a depth of 24 inches. In other places glacial till is within a depth of 60 inches. In some areas the soil is only occasionally flooded.

Included with this soil in mapping are small areas of the very poorly drained Saranac and Sloan soils. These soils are in depressions in slack-water areas. Also included are small areas of the well drained Stonelick Variant soils on the slightly higher parts of the landscape near the stream channels. Included soils make up 2 to 10 percent of the map unit.

The Shoals soil has a high available water capacity. Permeability is moderate in the upper part of the profile and rapid in the sandy part of the underlying material. The water table is at a depth of 1 to 3 feet during winter and early spring. Runoff is slow. The surface layer has a moderate organic matter content. This layer is friable, and tilth is good.

Most of the larger areas are used for cultivated crops. Most areas on small, narrow bottoms are pastured or remain wooded. This soil is a probable source of sand.

This soil is fairly well suited to corn, soybeans, and small grain. If protected against flooding, drained, and otherwise well managed, it can be intensively row cropped. Because of spring flooding, late planting or replanting may be necessary. Levees help to protect the soil against flooding. Subsurface drains help to remove excess water. Drains installed below a depth of 3 feet can be clogged by fine sand. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface reduce the hazard of scouring by floodwater, minimize crusting, improve tilth, and increase the rate of water infiltration.

If protected against flooding, this soil is well suited to grasses, such as orchardgrass, for hay or pasture. Legumes grow poorly in unprotected areas because of the flooding and the high water table. Branches and other debris deposited by floodwater can hinder haying. Overgrazing or grazing when the soil is wet results in surface compaction and poor tilth.

This soil is fairly well suited to trees. Plant competition and the equipment limitation are the main management concerns. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying. Harvesting activities can be interrupted by flooding. They should be restricted to dry periods or to periods when the ground is frozen.

Because of the flooding and the wetness, this soil is generally unsuitable as a site for dwellings and septic tank absorption fields. It is severely limited as a site for local roads because of the flooding and the potential for frost action. Constructing the roads on raised, well compacted fill material and providing adequate ditches and culverts minimize the damage caused by floodwater and frost action.

The land capability classification is IIIw. The woodland ordination symbol is 5W.

So—Sloan loam, sandy substratum, frequently flooded. This nearly level, deep, very poorly drained soil is on bottom land. It is flooded mainly in early spring. Areas are long and narrow and are 3 to 35 acres in size.

Typically, the surface layer is very dark gray loam about 10 inches thick. The subsurface layer is about 8 inches of very dark brown loam. The subsoil is about 36 inches of dark gray and very dark gray, mottled, firm and friable, stratified loam, silt loam, and sandy loam. The underlying material to a depth of 60 inches is grayish brown loamy coarse sand. In some places soil is underlain by sand and gravelly coarse sand within a depth of 24 inches. In other places it is underlain by glacial till within a depth of 60 inches. In a few places the surface layer is muck. In some areas the upper part of the solum is clayey. In other areas the soil is only occasionally flooded.

Included with this soil in mapping are undrained areas that stay wet most of the year. Also included are small areas of the very poorly drained Adrian and Palms soils in deep depressions and the somewhat poorly drained Shoals and well drained Stonelick Variant soils near the stream channels. Included soils make up 2 to 12 percent of the map unit.

The Sloan soil has a high available water capacity. Permeability is moderate or moderately slow in the solum and rapid in the sandy underlying material. The water table is at or near the surface during winter and early spring. Runoff is slow to ponded. The surface layer has a high organic matter content. This layer is friable, and tilth is good.

Most of the larger areas are used for cultivated crops. Most of the narrow bottom land is pastured or remains wooded. This soil is a probable source of sand and gravel.

If protected against flooding and drained, this soil is fairly well suited to corn, soybeans, and small grain. If protected against flooding, drained, and otherwise properly managed, it can be intensively row cropped. Because of spring flooding, late planting or replanting may be necessary. Levees help to protect the soil against flooding. Shallow surface drains and subsurface drains can remove excess water if outlets are available. These outlets are not readily available in some areas. Drains installed below a depth of 3 feet can be clogged by fine sand. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface reduce the hazard of scouring by floodwater, minimize crusting, improve tilth, and increase the rate of water infiltration.

This soil is well suited to grasses, such as reed canarygrass, for hay and pasture. Legumes grow poorly in unprotected areas because of the flooding and the high water table. Branches and other debris deposited by floodwater can hinder haying. Overgrazing or grazing when the soil is wet results in surface compaction and poor tilth.

This soil is fairly well suited to trees. Seedling mortality, the windthrow hazard, plant competition, and the equipment limitation are management concerns. Replanting of seedlings is often necessary. Water-tolerant species should be selected for planting. Competing vegetation can be controlled by cutting, girdling, or spraying. Carefully thinning the stands or not thinning them at all and applying harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Harvesting activities are restricted to dry periods or to periods when the ground is frozen.

Because of the flooding and the wetness, this soil is generally unsuitable as a site for dwellings and septic tank absorption fields. It is severely limited as a site for local roads because of the flooding, the wetness, and low strength. Constructing the roads on raised, well compacted fill material and providing adequate ditches and culverts help to prevent the structural damage caused by floodwater, wetness, and low strength.

The land capability classification is IIIw. The woodland ordination symbol is 4W.

SpB—Spinks sand, 2 to 6 percent slopes. This gently sloping, deep, well drained soil is on moraines. Areas are irregular in shape and are 2 to 10 acres in size.

Typically, the surface layer is very dark grayish brown sand about 11 inches thick. The subsurface layer is light yellowish brown, loose sand about 14 inches thick. The next 49 inches is pale brown, loose sand that has bands of dark brown, very friable loamy sand. The bands have a cumulative thickness of more than 8 inches. The underlying material to a depth of 80 inches is light yellowish brown sand. In some areas the soil has a continuous subsoil 4 to 28 inches thick. In a few areas it has no bands within a depth of 60 inches. In some areas the content of gravel is as much as 35 percent throughout the soil. In a few places the soil is underlain by glacial till.

Included with this soil in mapping are small areas of severely eroded soils and a few short slopes of more than 12 percent. Also included are small areas of the moderately well drained Rawson soils on the side slopes and foot slopes of knolls and ridges. Included soils make up 5 to 15 percent of the map unit.

The Spinks soil has a low available water capacity. Permeability is moderately rapid. Runoff is slow. The surface layer has a moderately low organic matter content. This layer is very friable, and tilth is good.

Most areas are used for hay or pasture. Some remain wooded or are being reforested. A few are used for cultivated crops. This soil is a probable source of sand.

This soil is fairly well suited to cultivated crops. Drought and soil blowing are the main management concerns. A cropping system that includes grasses and legumes, cover crops, and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control soil blowing, reduce the evaporation rate, and increase the organic matter content and the available water capacity. The soil is well suited to no-till farming.

This soil is well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay or pasture. The species that can grow well under droughty conditions should be selected for planting. Pasture rotation and timely deferment of grazing help to keep the pasture in good condition.

This soil is fairly well suited to trees. Seedling mortality and plant competition are the main management concerns. Replanting of seedlings may be necessary. Drought-tolerant species should be selected for planting. Competing vegetation can be controlled by cutting, girdling, or spraying.

This soil is suitable as a site for dwellings, local roads and streets, and septic tank absorption fields.

The land capability classification is IIIs. The woodland ordination symbol is 4S.

SpC—Spinks sand, 6 to 15 percent slopes. This moderately sloping, deep, well drained soil is on moraines. Areas are irregular in shape and are 3 to 15 acres in size.

Typically, the surface layer is very dark grayish brown sand about 10 inches thick. The next 56 inches is light yellowish brown sand and pale brown loamy sand that has bands of dark brown loamy sand. The bands have a cumulative thickness of more than 8 inches. The underlying material to a depth of 80 inches is light yellowish brown sand. In places the soil has a continuous subsoil 4 to 18 inches thick. In a few areas it has no bands within a depth of 60 inches. In some areas the content of gravel is as much as 35 percent throughout the soil. In a few areas the soil is underlain by glacial till.

Included with this soil in mapping are small areas of severely eroded soils and a few short slopes of more than 20 percent. Also included are small areas of the moderately well drained Rawson soils on the side slopes and foot slopes of knolls and ridges. Included soils make up 5 to 10 percent of the map unit.

The Spinks soil has a low available water capacity. Permeability is moderately rapid. Runoff is medium. The surface layer has a moderately low organic matter content. This layer is very friable, and tilth is good.

Most areas are used for hay, pasture, or woodland. A few are used for cultivated crops. This soil is a probable source of sand.

This soil is fairly well suited to cultivated crops. Drought and soil blowing are the main management concerns. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control soil blowing, reduce the evaporation rate, and increase the organic matter content and the available water capacity. The soil is well suited to no-till farming.

This soil is well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay or pasture. The species that can grow well under droughty conditions should be selected for planting. Pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the pasture in good condition.

This soil is fairly well suited to trees. Seedling mortality and plant competition are the main management concerns. Replanting of seedlings is often necessary. Competing vegetation can be controlled by cutting, girdling, or spraying.

Because of the slope, this soil is moderately limited as a site for dwellings, local roads and streets, and septic tank absorption fields. Buildings should be designed so that they can conform to the natural slope of the land. Roads and septic tank absorption fields should be built on the contour. Land shaping may be needed. Retaining as much of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion.

The land capability classification is IIIe. The woodland ordination symbol is 4S.

St—Stonelick Variant sandy loam, occasionally flooded. This nearly level, deep, well drained soil is on bottom land. It is occasionally flooded for brief periods. Areas are long and narrow and are 3 to 20 acres in size.

Typically, the surface layer is brown sandy loam about 10 inches thick. The upper part of the underlying material is dark brown and brown, very friable fine sandy loam and loamy fine sand. The lower part to a depth of 60 inches is gray and grayish brown, mottled, loose and friable fine sandy loam and sand. In places gravelly sand is at a depth of about 30 inches. In a few areas free carbonates are in the upper part of the profile. In some areas the solum has less sand and more silt and clay. In a few places glacial till is within a depth of 60 inches.

Included with this soil in mapping are small natural levees along river channels. The soils on these levees are sandy throughout. Also included are small areas of the somewhat poorly drained Shoals and very poorly drained Sloan soils. These soils are in the lower areas, in floodwater channels, and in slack-water areas. Included soils make up 2 to 15 percent of the map unit.

The Stonelick Variant soil has a moderate available water capacity. Permeability is moderately rapid. Runoff is slow. The surface layer has a moderate organic matter content. This layer is very friable, and tilth is good.

Most of the larger areas are used for cultivated crops. The small, narrow bottom land is pastured or remains wooded. It is a probable source of sand.

This soil is well suited to corn and soybeans. If protected against flooding, it can be intensively row cropped. Because of spring flooding, late planting or replanting may be necessary. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface reduce the hazard of scouring by floodwater, minimize crusting, improve tilth, and increase the rate of water infiltration. The soil is well suited to no-till farming.

If protected against flooding, this soil is well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay and pasture. Floodwater can damage the stand. Branches and other debris deposited by the floodwater can hinder haying. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth.

This soil is well suited to trees. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying.

Because of the flooding, this soil is generally unsuitable as a site for dwellings and sanitary facilities and is severely limited as a site for local roads. Constructing the roads on raised, well compacted fill material and providing adequate ditches and culverts help to prevent the road damage caused by floodwater.

The land capability classification is IIw. The woodland ordination symbol is 4A.

Ud—Udorthents, loamy. These nearly level to strongly sloping, deep, well drained to poorly drained soils are in disturbed areas on uplands, terraces, and bottom land. Areas are oval or rectangular and are 3 to 40 acres in size.

These soils are generally around landfills, highway interchanges, shopping centers, and factories and in agricultural areas. In some places, cuts have been made in the original land surface and the soil material has been used in smoothing and leveling lower lying areas. In other places the soil material has been removed and used as fill on highways, overpasses, and exit ramps. Water has filled some small areas.

Typically, the surface layer is dark yellowish brown clay loam about 3 inches thick. The underlying material to a depth of 60 inches is dark grayish brown clay loam.

Included with these soils in mapping are small areas of short, steep slopes and areas of sand, gravel, and stones. Also included in some areas are highways, landfills, and public works and buildings.

The Udorthents have a low to high available water capacity. Permeability is moderate to slow. The surface layer has a low organic matter content. This layer is firm, and tilth is poor.

Most areas support a permanent cover of grasses and low-growing shrubs or are being reforested. Special management is needed if these soils are used for cultivated crops, hay, or pasture. An intensified fertility program with special emphasis on the incorporation of organic residue or manure into the soils is needed if crops are grown. Measures that control erosion are needed in the gently sloping to strongly sloping areas. Land leveling is needed in some areas. A drainage system may be needed in the nearly level areas.

Exposed areas should be revegetated as soon as possible after construction.

Onsite investigation is needed if these soils are to be used for urban development. Because the soil properties that affect the design of a structure vary, engineering test data should be collected. Retaining as much of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion.

No land capability classification or woodland ordination symbol is assigned.

Wa—Wallkill silty clay loam. This nearly level, deep, very poorly drained soil is in deep depressions on till plains, moraines, and bottom land. It is often ponded by runoff from the higher adjacent slopes. Areas are oval or irregular in shape and are 3 to 10 acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 8 inches thick. The next 13 inches is dark grayish brown, friable silty clay loam. Below this to a depth of 60 inches is a buried soil of very dark grayish brown and black muck. In some areas the mineral material is less than 16 inches thick. In a few areas the soil is underlain by silty clay loam to sand. In places the muck is less than 16 inches thick and is underlain by coprogenous earth.

Included with this soil in mapping are undrained areas that stay wet most of the year. Also included are small areas of the very poorly drained Saranac soils along small stream channels and other mineral soils near the edge of the depressions. Saranac soils are less mucky than the Wallkill soil. Included soils make up 4 to 12 percent of the map unit.

The Wallkill soil has a very high available water capacity. Permeability is moderately slow to moderately rapid. The water table is near or above the surface during winter and spring. Runoff is very slow or ponded. The surface layer has a moderate organic matter content. This layer is friable, and tilth is fair.

Most areas of this soil are used for cultivated crops. Some are used as pasture. A few support marsh vegetation.

If drained, this soil is fairly well suited to corn, soybeans, and small grain. If drained and properly managed, it can be intensively row cropped. Wetness and ponding are the main management concerns. Most crops grow poorly in undrained areas. Most areas cannot be easily drained. Many do not have an adequate drainage outlet. Clay and concrete tile installed in the organic material settles and falls out of alignment. Because of the poor stability of the organic material, ditchbanks cave in. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface minimize crusting, improve tilth, and increase the rate of water infiltration.

This soil is well suited to grasses, such as reed canarygrass, for hay or pasture. Deep-rooted legumes, such as alfalfa, grow poorly because of the ponding and the high water table. Even if drainage tile is installed, the legumes can be damaged by ponding. Overgrazing or grazing when the soil is wet results in surface compaction and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to trees. Seedling mortality, the windthrow hazard, the equipment limitation, and plant competition are management concerns. Replanting of seedlings is often necessary. Water-tolerant species should be selected for planting. Competing vegetation can be controlled by cutting, girdling, or spraying. Carefully thinning the stands or not thinning them at all and applying harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Harvesting activities are restricted to dry periods or to periods when the ground is frozen.

Because of the ponding and low strength, this soil is generally unsuitable as a site for dwellings, local roads and streets, and septic tank absorption fields. Extensive changes are needed to make the soil suitable for these uses. An alternative site should be selected.

The land capability classification is IIIw. The woodland ordination symbol is 3W.

Wc—Wallkill silty clay loam, coprogenous earth substratum. This nearly level, deep, very poorly drained soil is in deep depressions on till plains, moraines, and bottom land. It is ponded by runoff from the higher adjacent slopes. Areas are oval or irregular in shape and are 3 to 10 acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 9 inches thick. The next 13 inches is dark grayish brown and grayish brown, firm and friable silty clay loam. Below this is a buried soil of dark reddish brown, very dark grayish brown, and very dark brown muck about 19 inches thick. The substratum to a depth of 60 inches is dark grayish brown and very dark grayish brown coprogenous earth. In a few places the mineral material is less than 16 inches thick. In a few areas the soil is underlain by silty clay loam to sand. In some places the muck is less than 8 inches thick. In other places the mineral material is darker. In some areas the coprogenous earth is underlain by mineral material within a depth of 60 inches.

Included with this soil in mapping are undrained areas that stay wet most of the year. Also included are small areas of very poorly drained, mineral soils near the edge of the depressions. Included soils make up 4 to 10 percent of the map unit.

The Wallkill soil has a very high available water capacity. Permeability is moderately slow to moderately rapid in the mineral material and the muck and slow in the coprogenous earth. The water table is near or above the surface during winter and spring. Runoff is very slow or ponded. The surface layer has a moderate organic matter content. This layer is friable, and tilth is fair.

Most areas of this soil are used for cultivated crops. Some are used for pasture. A few support marsh vegetation.

If drained, this soil is fairly well suited to corn, soybeans, and small grain. If drained and properly managed, it can be intensively row cropped. Wetness and ponding are the main management concerns. Most crops grow poorly in undrained areas. Most areas cannot be easily drained. Many do not have an adequate drainage outlet. Clay and concrete tile installed in the organic material settles and falls out of alignment. Because of the slow permeability, subsurface drains installed in the coprogenous earth remove excess water from only a small area. Because of the poor stability of the organic material, ditchbanks cave in. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface minimize crusting, improve tilth, and increase the rate of water infiltration.

This soil is well suited to grasses, such as reed canarygrass, for hay or pasture. Deep-rooted legumes, such as alfalfa, grow poorly because of the ponding and the high water table. Even if drainage tile is installed, the legumes can be damaged by ponding. Overgrazing or grazing when the soil is wet results in surface compaction and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to trees. Seedling mortality, the windthrow hazard, the equipment limitation, and plant competition are management concerns. Replanting of seedlings is often necessary. Water-tolerant species should be selected for planting. Competing vegetation can be controlled by cutting, girdling, or spraying. Carefully thinning the stands or not thinning them at all and applying harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Harvesting activities are restricted to dry periods or to periods when the ground is frozen.

Because of the ponding and low strength, this soil is generally unsuitable as a site for dwellings, local roads and streets, and septic tank absorption fields. Extensive changes are needed to make the soil suitable for these uses. An alternative site should be selected.

The land capability classification is IIIw. The woodland ordination symbol is 3W.

WmB—Wawasee sandy loam, 2 to 6 percent slopes. This gently sloping, deep, well drained soil is on moraines. Areas are irregular in shape and are 3 to 30 acres in size.

Typically, the surface layer is dark grayish brown sandy loam about 9 inches thick. The subsoil is about 22 inches of yellowish brown, firm loam and clay loam. The underlying material to a depth of 60 inches is yellowish brown sandy loam. In some places the content of gravel in the subsoil is as much as 10 percent. In other places the solum is less than 28 or as much as 48 inches thick. In some areas the surface layer is loamy sand. In other areas the subsoil has more clay. In some places the soil is moderately eroded. In other places the slope is more than 6 percent.

Included with this soil in mapping are small areas of soils that are severely eroded and have a surface layer of sandy clay loam. Also included are small areas of the somewhat poorly drained Crosier and very poorly drained Brookston soils on foot slopes, along narrow drainageways, and in small depressions. Included soils make up 2 to 10 percent of the map unit.

The Wawasee soil has a high available water capacity. Permeability is moderate. Runoff is medium. The surface layer has a moderate organic matter content. This layer is friable, and tilth is good.

Most areas of this soil are used for cultivated crops. Some are used for hay or pasture. A few remain wooded.

This soil is well suited to corn, soybeans, and small grain. Erosion and soil blowing are the main management concerns. A few cobbles or stones on or near the surface can hinder fieldwork. A cropping system that includes grasses and legumes, diversions, contour farming, grassed waterways, and grade stabilization structures help to control erosion and runoff. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control erosion and soil blowing, minimize crusting, improve tilth, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay or pasture. Overgrazing or grazing when the soil is wet results in surface compaction, excessive runoff, and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying.

This soil is suitable as a site for dwellings. It is moderately limited as a site for local roads and streets because of frost action. Replacing or covering the upper soil layers with suitable base material helps to prevent the damage caused by frost action. Because of the moderate permeability, this soil is moderately limited as a site for septic tank absorption fields. Enlarging the absorption field helps to compensate for the restricted permeability.

The land capability classification is IIe. The woodland ordination symbol is 5A.

WmC—Wawasee sandy loam, 6 to 15 percent slopes. This moderately sloping, deep, well drained soil is on moraines. Areas are irregular in shape and are 3 to 25 acres in size.

Typically, the surface layer is dark brown sandy loam about 9 inches thick. The subsoil is about 21 inches of dark yellowish brown and yellowish brown, firm and friable clay loam and loam. The underlying material to a depth of 60 inches is yellowish brown sandy loam. In places the content of gravel in the subsoil is as much as 10 percent. In a few areas the surface layer is loamy sand. In some areas the solum is less than 28 or as much as 48 inches thick. In other areas the subsoil has more clay. In some places the soil is moderately eroded. In other places the slope is less than 6 or more than 15 percent.

Included with this soil in mapping are small areas of soils that are severely eroded and have a surface layer of sandy clay loam. Also included are small breaks that have a slope of more than 18 percent and small areas of the somewhat poorly drained Crosier and very poorly drained Brookston soils on foot slopes and along narrow drainageways. Included soils make up 2 to 10 percent of the map unit.

The Wawasee soil has a high available water capacity. Permeability is moderate. Runoff is medium. The surface layer has a moderate organic matter content. This layer is friable, and tilth is good.

Most areas of this soil are used for cultivated crops. Many are used for hay or pasture. A few remain wooded or are used as wildlife habitat.

This soil is fairly well suited to corn, soybeans, and small grain. Erosion and soil blowing are the main management concerns. A few cobbles or stones on or near the surface can hinder fieldwork. A cropping system that includes grasses and legumes, diversions, contour farming, grassed waterways, and grade stabilization structures help to control erosion and runoff. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface help to control erosion and soil blowing, minimize crusting, improve tilth, and increase the rate of water infiltration. The soil is well suited to no-till farming.

This soil is well suited to grasses, such as orchardgrass, and legumes, such as alfalfa, for hay or pasture. Overgrazing or grazing when the soil is wet results in surface compaction, excessive runoff, and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying.

Because of the slope, this soil is moderately limited as a site for dwellings. The slope should be modified by land grading, or the buildings should be designed so that they conform to the natural slope of the land. Retaining as much of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion. Because of the potential for frost action and the slope, the soil is moderately limited as a site for local roads and streets. Replacing or covering the upper soil layers with suitable base material helps to prevent the road damage caused by frost action. Constructing the roads and streets on the contour and land shaping help to overcome the slope.

Because of the slope and the moderate permeability, this soil is moderately limited as a site for septic tank absorption fields. Installing the absorption field on the contour helps to overcome the slope. Enlarging the absorption field helps to compensate for the restricted permeability.

The land capability classification is IIIe. The woodland ordination symbol is 5A.

Wt—Whitaker loam. This nearly level, deep, somewhat poorly drained soil is on river terraces and outwash plains. Areas are irregular in shape and are 2 to 15 acres in size.

Typically, the surface layer is dark grayish brown loam about 10 inches thick. The subsurface layer is about 4 inches of grayish brown, mottled loam. The subsoil is about 44 inches of yellowish brown, dark grayish brown, grayish brown, and gray, mottled, friable and firm loam, clay loam, silty clay loam, and sandy clay loam. The underlying material to a depth of 60 inches is grayish brown, mottled, stratified loamy fine sand and fine sand. In some places the solum is less than 40 or more than 60 inches thick. In other places the soil is underlain by glacial till within a depth of 60 inches. In some areas it has a gravelly subsoil or is underlain by gravel. In other areas the upper part of the subsoil has more clay.

Included with this soil in mapping are small areas of the well drained Martinsville soils on rises and the very poorly drained Rensselaer soils in narrow drainageways and depressions. Included soils make up 2 to 8 percent of the map unit.

The Whitaker soil has a high available water capacity. Permeability is moderate. The water table is at a depth of 1 to 3 feet during winter and early spring. Runoff is slow. The surface layer has a moderate organic matter content. This layer is friable, and tilth is good.

Most areas of this soil are used for cultivated crops. Some are used for hay or pasture. A few remain wooded, but many of these are being cleared for cultivation.

This soil is well suited to corn, soybeans, and small grain. If drained and properly managed, it can be intensively row cropped. Wetness is the main management concern. Subsurface drains help to remove excess water. Drains installed below a depth of 3 feet can be clogged by fine sand. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface minimize crusting, improve tilth, and increase the rate of water infiltration.

This soil is well suited to grasses, such as orchardgrass, and some legumes, such as ladino clover, for hay or pasture. Deep-rooted legumes, such as alfalfa, grow poorly in undrained areas because of the seasonal high water table. Overgrazing or grazing when the soil is wet results in surface compaction and poor tilth. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled by cutting, girdling, or spraying.

Because of the wetness, this soil is severely limited as a site for dwellings and septic tank absorption fields. Dwellings should be constructed without basements. Subsurface drains help to lower the water table. Interceptor drains are needed around septic tank absorption fields. Because of frost action, the soil is severely limited as a site for local roads and streets. Constructing the roads on raised, well compacted fill material and providing adequate ditches and culverts minimize the damage caused by frost action.

The land capability classification is IIw. The woodland ordination symbol is 4A.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise 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 food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. 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 has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 155,000 acres in the survey area, or nearly 72 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county, but most are in the southern and eastern parts, mainly in associations 4 and 5, which are described under the heading "General Soil Map Units." About 120,000 acres of the prime farmland is used for crops. The crops grown on this land, mainly corn, soybeans, and winter wheat, account for an estimated one-half of the county's total agricultural income each year.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table and all soils that are frequently flooded during the growing season qualify for prime farmland only in areas where these limitations have been overcome by drainage measures or flood control. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not these limitations have been overcome by corrective measures.

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 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.

Crops and Pasture

Samuel E. St. Clair, district conservationist, Kathleen Latz, soil conservationist, and Joe R. Peden, conservation agronomist, Soil Conservation Service, helped prepare 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 not commonly 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.

About 137,000 acres in the county is used for harvested grain crops, mainly corn, soybeans, and wheat; 12,000 acres for rotation hay and pasture; and 1,600 acres for permanent pasture. The acreage used for harvested grain crops and for urban development is gradually increasing, whereas the acreage of woodland, pasture, hayland, and wetland is decreasing. Woodland is being cleared and wetland drained for use as cropland. Fewer areas of pasture and hayland are needed because the number of livestock farms is decreasing.

The paragraphs that follow describe the major management concerns in the areas of the county used for crops and pasture. These concerns are erosion, wetness, fertility, and tilth.

Erosion is the major problem on about 54 percent of the cropland and 26 percent of the pasture in the county. Loss of the surface layer through erosion reduces the productivity of a soil by decreasing the organic matter content and the level of fertility in the topsoil. It is especially damaging on soils that have a clayey subsoil, such as Morley, Blount, and Glynwood soils. The clayey subsoil is mixed with the plow layer as erosion occurs. Because of the increased content of clay, working the soil is more difficult and more horsepower is needed to operate tillage equipment. The poor structure of the eroded soil hinders root penetration and reduces the supply of available moisture.

Erosion also affects water quality. The deposition of sediment and the accompanying nutrients and pesticides reduces the capacity of streams, ditches, and lakes to collect and carry water. In many of the lakes in the county, the growth of weeds and algae is accelerated because of the nutrients and pesticides deposited along with the eroding sediment. Erosion control improves the productivity of the soils, maintains the drainage capacity of the streams, ditches, and lakes, and improves water quality for recreation and for fish and wildlife.

Most of the erosion in Whitley County is caused by surface water. A good vegetative cover helps to protect the soil. Plants and plant roots act as a cushion to absorb the impact of raindrops before they contact the soil. Thus, more water penetrates the surface and less is lost as runoff.

A cropping system that protects the soil from water erosion and soil blowing and that improves the physical condition of the soil increases soil productivity. Conservation tillage, winter cover crops, green manure crops, and a cropping system that includes grasses and legumes help to control erosion. Including grasses and legumes in the crop rotation also improves tilth and increases the supply of plant nutrients. In areas of well drained soils on uplands, no-till farming helps to control erosion and reduces the amount of fuel needed for crop production.

A combination of conservation practices may be necessary if rolling areas are intensively cultivated. Grassed waterways channel excess surface water and slow runoff on the more sloping soils, such as Morley and Miami soils. These waterways also are needed where a large watershed drains across many areas of Rawson and Glynwood soils. A permanent cover of grasses helps to control erosion in the waterway. A tile drain installed along the grassed waterway reduces wetness. Grade stabilization structures are needed in areas where a change in grade allows water to drop so quickly that erosion occurs. These structures commonly are needed where the grassed waterway enters an open ditch.

Water- and sediment-control basins, terraces, and diversions help to control runoff on gently sloping and moderately sloping soils. Water- and sediment-control basins and terraces store runoff behind earthen dams until the water can enter subsurface drains. Diversions conduct water to grassed waterways, which empty into suitable outlets.

Erosion cannot be entirely prevented, but it can be controlled to the point where it does not diminish the productive capacity of the soil. When a resource management system is designed for a particular farm or field, several factors should be considered. These factors include the type of farming operation, the soil type, the length and steepness of slopes, the crop rotation, tillage methods, and rainfall patterns. Further information about the design of erosion-control measures is available at the local office of the Soil Conservation Service.

Wetness is a problem on at least 25 percent of the cropland in the county. A drainage system is needed if very poorly drained soils, such as Pewamo, Milford, and Houghton soils, are intensively row cropped. A few areas of these soils, however, cannot be economically drained. These are areas in deep depressions where gravity outlets are not available. Pumps are needed in these areas (fig. 11).

The design of both surface and subsurface drainage systems varies with the type of soil. A combination of surface and subsurface drains is needed in most areas of the very poorly drained soils that are intensively row cropped. The drains should be more closely spaced in slowly permeable soils than in the more rapidly permeable soils. Locating adequate outlets is difficult in some areas of Boots, Houghton, and Palms soils.

Houghton and other organic soils oxidize and subside when their pore space is filled with air. Therefore, special drainage systems are needed to control the depth and the period of drainage. Keeping the water table at the level required by the crops during the growing season and raising it to the surface during the rest of the year minimize oxidation and subsidence of these soils.

Information about the design of drainage systems for each kind of soil is available in the local office of the Soil Conservation Service.

Fertility refers to the amount of nutrients available to plants. In Morley and Boyer soils and in most of the other soils on uplands and terraces in the county, natural fertility is low or medium because the nutrients have been leached away and the soils tend to be slightly acid. Natural fertility is high in Sloan, Shoals, and Pewamo soils and in other soils on bottom land and in depressions. These soils receive runoff from the adjacent soils, have not been significantly leached of plant nutrients, and are neutral or mildly alkaline.

If no fertilizer is added in areas where crops are grown year after year, the supply of available plant nutrients is decreased and the soils become more acid. Applications of fertilizer and lime increase the supply of available nutrients and raise the pH level of the soil. On all soils additions of fertilizer and lime should be based on the results of soil tests, the needs of the crop, and the expected level of yields. The Cooperative Extension Service can help in determining the kinds and amounts to be applied.

Tilth is an important factor affecting the preparation of a seedbed, the germination of seeds, and the infiltration of water into the soil. In areas where tilth is good, the soils have good structure and are friable and porous. In areas where tilth is poor, preparing a good seedbed is difficult. The soils in these areas are cloddy and tend to dry out slowly. When they do dry out, they become hard. A surface crust forms during periods of rainfall. The hard crust reduces the rate of water infiltration and increases the runoff rate. This crust makes it very difficult for germinating seeds to break through the surface.

Adding crop residue, manure, or other organic material to the soil helps to maintain or improve tilth. Excessive tillage tends to break down soil structure and tilth, especially when the soils are wet. Applying a system of conservation tillage when moisture conditions are favorable minimizes the damage to soil structure. Fall plowing generally does not improve the tilth of the soils in Whitley County. It increases the hazard of erosion

Figure 11.—A pump in an area of Houghton soils.

throughout the winter and in early spring. The few soils that can be improved by fall plowing are the dark soils in nearly level or depressional areas. Milford and Pewamo soils, which are high in content of clay, are examples. Ridge planting is an alternative tillage system that is well suited to these soils.

Field crops suited to the soils and climate of the county include some that are not commonly grown. Corn and soybeans are the main row crops. Wheat and oats are the chief close-grown crops. Rye and sunflowers can be grown. Seed can be produced for legumes, such as red clover and crownvetch, and grasses, such as bluegrass, bromegrass, fescue, and redtop.

The *hay and pasture plants* commonly grown in the county include alfalfa, red clover, timothy, Kentucky bluegrass, smooth bromegrass, and orchardgrass. Birdsfoot trefoil and tall fescue also can be grown. The legumes grow well on the well drained, more sloping soils, such as Miami and Morley soils. The grasses are commonly grown on well drained soils. Reed canarygrass and tall fescue can be grown on poorly drained soils.

Specialty crops are of limited commercial importance in the county. A small acreage of organic soils is used for sod, onions, potatoes, and mint. If drained, Houghton and other organic soils have excellent potential for specialty crops. A small acreage of well drained soils is used for apple orchards, nursery plants, and Christmas trees. Soils in low areas where frost is frequent are poorly suited to early vegetables and orchards.

Information about growing specialty crops can be obtained from the Cooperative Extension 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 land capability classification of each map unit also is shown in the table.

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 ensures 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 for those crops.

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 criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include 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.

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 few limitations that restrict their use.

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

Class III soils have severe limitations that reduce the choice of plants 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.

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" and in the yields table.

Woodland Management and Productivity

Michael D. Warner, forester, Soil Conservation Service, helped prepare 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 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 an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The number 1 indicates low potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; *F*, a high content of rock fragments in the soil; and *L*, low strength. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, F, and L.

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

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, fire lanes, and log-handling areas. Forests that have been burned or overgrazed are also subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment or season of use is not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *volume* number. The site 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.

The *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced on a fully stocked, even-aged, unmanaged stand.

The first species listed under *common trees* for a soil is the indicator species for that soil. It is the dominant species on the soil and the one that determines the ordination class.

Trees to plant are those that are suitable for 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, help to keep 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 ensure 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 expected 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 commercial nursery.

Recreation

Several areas in the county are used for outdoor recreational activities, such as fishing, hunting, boating, swimming, and camping. Most of these areas are around the natural lakes in the northern part of the county.

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 gentle 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 and horseback riding 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, biologist, Soil Conservation Service, helped prepare 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, and soybeans.

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 bluegrass, timothy, orchardgrass, bromegrass, 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 ragweed, goldenrod, wild carrot, foxtail, and dock.

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

Coniferous plants furnish browse and seeds. 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, and cedar.

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, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, cattail, waterplantain, 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 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 (fig. 12). These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, mourning dove, pheasant, meadowlark, killdeer, field sparrow, cottontail rabbit, woodchuck, and red fox.

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 blue jay, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and white-tailed deer.

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

Edge habitat consists of areas where major land uses or cover types adjoin. A good example is the border between dense woodland and a field of no-till corn. Although not rated in the table, edge habitat is of primary importance to animals from the smallest songbirds to white-tailed deer. Most of the animals that inhabit openland or woodland also frequent edge habitat, and desirable edge areas are consistently used by 10 times

Figure 12.—Good openland wildlife habitat in an area of Morley soils.

as many wildlife as are the centers of large areas of woodland or cropland.

Engineering

Max L. Evans, state conservation engineer, Soil Conservation Service, helped prepare 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, 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 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, large stones, slope, 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. 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, and the available water capacity in the upper 40 inches 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 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, and flooding affect absorption of the effluent. Large stones 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 are 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 filter the effluent effectively. 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, 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 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, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, and soil reaction 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 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, 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 or stones, 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 or stones, 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 excavated 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, 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 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 or of organic matter. 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 and by permeability of the aquifer. The content of large stones affects 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 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 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, and large stones affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing 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, and slope affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, 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.

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.

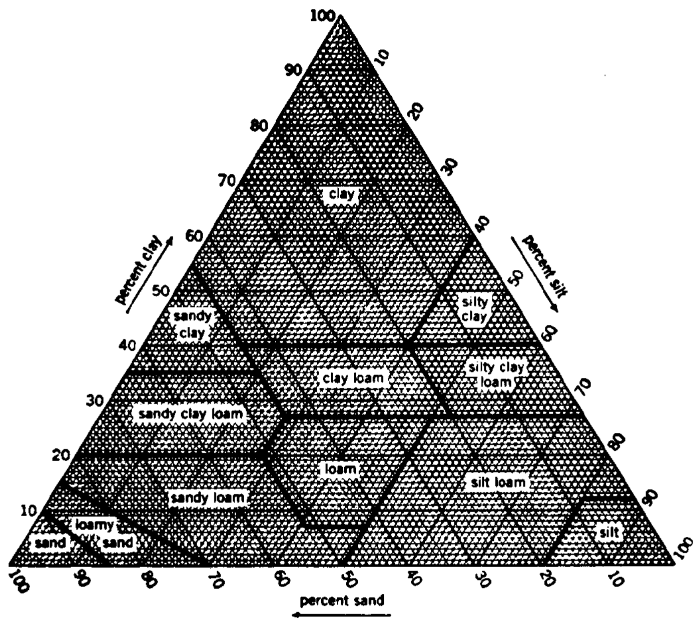

Figure 13.—Percentages of sand, silt, and clay in the basic USDA soil textural classes.

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 (fig. 13). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, 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, CL-ML.

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 ovendry 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.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

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 earthmoving 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 soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. 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 soil blowing 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 soil blowing 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 soil blowing 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 soil blowing are used.

5. Loamy soils that are less than 20 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 soil blowing are used.

6. Loamy soils that are 20 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 soil blowing.

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 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, tilth, and the effectiveness of most herbicides and pesticides. 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.

If a soil is assigned to two hydrologic groups in table 18, the first letter is for drained areas and the second is for undrained areas.

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 is not considered flooding, nor is water in swamps and marshes.

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, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, 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 are 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 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. 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.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence results from either desiccation and shrinkage or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. Table 18 shows the expected initial subsidence, which usually is a result of drainage, and total subsidence, which usually is a result of oxidation.

Not shown in the table is subsidence caused by an imposed surface load or by the withdrawal of ground water throughout an extensive area as a result of lowering the water table.

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 the 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 (*5*). 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. Table 19 shows the classification of the soils in the survey area. 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 *sol*. An example is Alfisol.

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 Alfisol).

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 *udalf*, the suborder of the Alfisols that has 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 Their 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* (*5*). 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."

Adrian Series

The Adrian series consists of deep, very poorly drained soils in deep depressions on bottom land, outwash plains, and terraces. These soils formed in organic material over sandy outwash. They are moderately slowly permeable to moderately rapidly permeable in the organic material and rapidly permeable in the underlying material. Slopes range from 0 to 2 percent.

Adrian soils are similar to Houghton, Martisco, Muskego, and Palms soils and are adjacent to Granby, Rensselaer, and Sloan soils. Houghton soils are organic to a depth of more than 51 inches. Martisco soils are underlain by marl. Muskego soils are underlain by coprogenous earth. Palms soils are underlain by loamy material. Granby, Rensselaer, and Sloan are mineral soils. They are at the slightly higher edges of the depressions and along stream channels on bottom land.

Typical pedon of Adrian muck, drained, in a cultivated field; 280 feet north and 1,820 feet west of the southeast corner of sec. 23, T. 31 N., R. 9 E.

Op—0 to 10 inches; sapric material, black (10YR 2/1) broken face, pressed, and rubbed; about 3 percent fiber, a trace rubbed; weak fine granular structure; very friable; common fine roots; herbaceous fibers; about 40 percent mineral material; neutral; abrupt smooth boundary.

Oa1—10 to 16 inches; sapric material, black (10YR 2/1) broken face, pressed, and rubbed; about 4 percent fiber, a trace rubbed; moderate fine granular structure; friable; few fine roots; herbaceous fibers; about 25 percent mineral material; neutral; clear smooth boundary.

Oa2—16 to 21 inches; sapric material, black (10YR 2/1) broken face, very dark brown (10YR 2/2) pressed and rubbed; about 3 percent fiber, a trace rubbed; massive; few fine roots; herbaceous fibers; about 60 percent mineral material; neutral; abrupt smooth boundary.

Cg1—21 to 28 inches; very dark gray (10YR 3/1) loamy fine sand; common coarse distinct dark yellowish brown (10YR 4/4) mottles; single grain; loose; few fine roots; about 1 percent gravel; neutral; gradual smooth boundary.

Cg2—28 to 43 inches; dark gray (10YR 4/1) loamy fine sand; many medium faint brown (10YR 4/3) mottles; single grain; loose; about 5 percent gravel; neutral; abrupt smooth boundary.

Cg3—43 to 60 inches; very dark gray (10YR 3/1) gravelly loamy sand; few coarse faint brown (10YR 4/3) mottles; single grain; loose; about 20 percent gravel; strong effervescence; moderately alkaline.

The organic material is 16 to 50 inches thick. The fiber is derived primarily from herbaceous plants. Reaction is medium acid to neutral in the organic material and slightly acid to moderately alkaline in the underlying material.

The surface and subsurface tiers have hue of 10YR or 7.5YR or are neutral in hue. They have chroma of 0 to 2. Some pedons have a layer of coprogenous earth directly above the C horizon. This layer is as much as 2 inches thick. The C horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 1 or 2. It is loamy fine sand to gravelly sand.

Blount Series

The Blount series consists of deep, somewhat poorly drained, slowly permeable soils on slight rises on till plains and in gently sloping areas on moraines. These soils formed in dense glacial till. Slopes range from 0 to 4 percent.

Blount soils are similar to Fulton and Haskins soils and are adjacent to Glynwood, Morley, and Pewamo soils. Fulton soils are stratified in the underlying material. Haskins soils have less clay and more sand in the upper part of the subsoil than the Blount soils. The moderately well drained Glynwood and well drained Morley soils have fewer mottles in the upper part of the subsoil than the Blount soils. They are in the more sloping areas. Pewamo soils are very poorly drained and are in depressions and drainageways. They have a surface layer that is thicker and darker than that of the Blount soils and are dominantly grayish in the subsoil.

Typical pedon of Blount silt loam, 1 to 4 percent slopes, eroded, in a cultivated field; 225 feet south and 1,200 feet east of the northwest corner of sec. 29, T. 31 N., R. 9 E.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; mixed with dark yellowish brown (10YR 4/4) clay; weak medium granular structure; friable; common fine roots; medium acid; abrupt smooth boundary.

Bt1—10 to 14 inches; dark yellowish brown (10YR 4/4) clay; many fine distinct dark grayish brown (10YR 4/2) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin continuous dark grayish brown (10YR 4/2) clay films on faces of peds; few black (10YR 2/1) iron and manganese concentrations; few glacial pebbles; slightly acid; clear wavy boundary.

Bt2—14 to 21 inches; dark yellowish brown (10YR 4/4) clay; many fine distinct grayish brown (10YR 5/2) mottles; moderate coarse subangular blocky structure; firm; few fine roots; thin continuous dark grayish brown (10YR 4/2) clay films on faces of peds; few glacial pebbles; neutral; clear wavy boundary.

BC—21 to 25 inches; yellowish brown (10YR 5/4) clay loam; many medium distinct grayish brown (10YR 5/2) mottles; moderate medium angular blocky structure; firm; few fine roots; thin continuous dark grayish brown (10YR 4/2) clay films on faces of peds; few glacial pebbles; slight effervescence; mildly alkaline; gradual wavy boundary.

C—25 to 60 inches; yellowish brown (10YR 5/4) clay loam; many coarse distinct grayish brown (10YR 5/2) mottles; massive; very firm; thin continuous light gray (10YR 6/1) calcium carbonate deposits in cracks; few glacial pebbles; strong effervescence; moderately alkaline.

The solum is 22 to 40 inches thick. Reaction is neutral to medium acid in the A, E, and Bt horizons and neutral or mildly alkaline in the BC horizon.

The Ap horizon has chroma of 2 or 3. Pedons in undisturbed areas have an A horizon, which has hue of 10YR, value of 3, and chroma of 1 or 2. The Ap or A horizon is dominantly silt loam but in some pedons is loam.

Some pedons have an E horizon. This horizon has hue of 10YR, value of 4 or 5, chroma of 1 or 2 and is mottled. It is silt loam.

The Bt horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It is clay, clay loam, silty clay loam, or silty clay. The BC horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It is clay loam or silty clay loam.

The C horizon has hue of 10YR or 2.5Y and chroma of 3 or 4. It is clay loam or silty clay loam.

Boots Series

The Boots series consists of deep, very poorly drained, moderately permeable to moderately rapidly permeable soils in old glacial lakebeds on moraines. These soils formed in thick deposits of organic material. Slopes are 0 to 1 percent.

Boots soils are similar to Houghton soils and are adjacent to Milford and Pewamo soils. Houghton soils have a lower content of fiber in the subsurface and bottom tiers than the Boots soils. Milford and Pewamo are mineral soils. They are at the slightly higher edges of the depressions.

Typical pedon of Boots muck, undrained, in a swamp; 1,900 feet south and 300 feet east of the northwest corner of sec. 3, T. 32 N., R. 8 E.

Op—0 to 6 inches; sapric material, black (5YR 2/1) broken face, pressed, and rubbed; about 2 percent fiber, a trace rubbed; moderate fine granular structure; very friable; many fine roots; herbaceous fibers; about 20 percent mineral material; neutral; abrupt smooth boundary.

Oa1—6 to 10 inches; sapric material, black (10YR 2/1) broken face, pressed, and rubbed; about 2 percent fiber, a trace rubbed; weak fine granular structure; friable; few fine roots; herbaceous fibers; about 15 percent mineral material; neutral; clear wavy boundary.

Oa2—10 to 15 inches; sapric material, black (10YR 2/1) broken face, pressed, and rubbed; about 30 percent fiber, 12 percent rubbed; weak medium granular structure; friable; few fine roots; herbaceous fibers; about 10 percent mineral material; neutral; clear smooth boundary.

Oe1—15 to 32 inches; hemic material, dark reddish brown (5YR 3/2 and 2/2) broken face, pressed, and rubbed; about 80 percent fiber, 20 percent rubbed; massive; friable; herbaceous fibers; about 5 percent mineral material; neutral; clear smooth boundary.

Oe2—32 to 42 inches; hemic material, dark brown (10YR 3/3) broken face and pressed, very dark brown (10YR 2/2) rubbed; about 90 percent fiber, 35 percent rubbed; massive; friable; herbaceous fibers; about 5 percent mineral material; neutral; clear smooth boundary.

Oe3—42 to 52 inches; hemic material, dark brown (10YR 3/3) broken face and pressed, very dark grayish brown (10YR 3/2) rubbed; about 95 percent fiber, 38 percent rubbed; massive; friable; herbaceous fibers; about 5 percent mineral material; neutral; clear smooth boundary.

Oe4—52 to 60 inches; hemic material, dark brown (10YR 3/3) broken face and pressed, very dark brown (10YR 2/2) rubbed; about 90 percent fiber, 35 percent rubbed; massive; friable; herbaceous fibers; about 5 percent mineral material; neutral.

The organic material is more than 51 inches thick. It is medium acid to neutral. The fiber is derived primarily from herbaceous plants. The sapric material is 10 to 20 inches thick.

The Op and Oa horizons have hue of 10YR to 5YR, value of 2 or 3, and chroma of 1 or 2. They are dominantly sapric material. The Oe horizon has a hue of 10YR to 5YR, value of 2 or 3, and chroma of 1 to 3. It is dominantly hemic material.

Boyer Series

The Boyer series consists of deep, well drained soils on outwash plains, river terraces, and moraines. These soils formed in loamy outwash over sandy and gravelly outwash (fig. 14). Permeability is moderately rapid in the solum and very rapid in the underlying material. Slopes range from 0 to 20 percent.

Boyer soils are similar to Kalamazoo, Ormas, and Oshtemo soils and are commonly adjacent to Homer and Sebewa soils. Kalamazoo and Oshtemo soils have a solum that is thicker than that of the Boyer soils. Ormas soils have more sand and less clay in the upper part of the solum than the Boyer soils. The somewhat poorly drained Homer and very poorly drained Sebewa soils are in the lower areas and in depressions. They have a subsoil that is grayer than that of the Boyer soils.

Typical pedon of Boyer sandy loam, 2 to 6 percent slopes, in a cultivated field; 500 feet north and 1,160 feet east of the southwest corner of sec. 3, T. 31 N., R. 10 E.

Ap—0 to 10 inches; dark brown (10YR 4/3) sandy loam, pale brown (10YR 6/3) dry; moderate medium granular structure; friable; few fine roots; about 4 percent gravel; medium acid; abrupt smooth boundary.

Figure 14.—Profile of Boyer soils, which formed in loamy outwash over sandy and gravelly outwash.

Bt1—10 to 14 inches; dark brown (7.5YR 4/4) sandy loam; moderate medium subangular blocky structure; friable; few fine roots; thin patchy dark brown (7.5YR 4/4) clay films on faces of peds; thin discontinuous dark brown (10YR 3/3) organic coatings on vertical faces of peds; about 6 percent gravel; medium acid; clear wavy boundary.

Bt2—14 to 20 inches; dark brown (7.5YR 4/4) gravelly sandy loam; moderate medium subangular blocky structure; friable; few fine roots; thin continuous dark brown (7.5YR 4/4) clay films on faces of peds; about 18 percent gravel; medium acid; clear wavy boundary.

Bt3—20 to 23 inches; dark brown (7.5YR 4/4) gravelly sandy loam; moderate medium subangular blocky structure; friable; few fine roots; thin continuous dark brown (7.5YR 4/4) clay films on faces of peds; about 25 percent gravel; neutral; abrupt wavy boundary.

Bt4—23 to 29 inches; dark brown (7.5YR 4/4) sandy loam; weak medium subangular blocky structure; very friable; few fine roots; thin patchy dark brown (7.5YR 4/4) clay bridges between sand grains; about 2 percent gravel; neutral; abrupt wavy boundary.

Bt5—29 to 32 inches; dark brown (7.5YR 4/4) gravelly sandy loam; weak medium subangular blocky structure; friable; thin continuous dark brown (7.5YR 4/4) clay films on faces of peds; about 25 percent gravel; neutral; abrupt irregular boundary.

2C—32 to 60 inches; pale brown (10YR 6/3) stratified sand and gravelly coarse sand; single grain; loose; about 30 percent gravel; strong effervescence; moderately alkaline.

The solum is 24 to 40 inches thick. It is slightly acid or medium acid in the upper part and medium acid to mildly alkaline in the lower part.

The Ap horizon has value of 4 or 5 and chroma of 2 or 3. It is dominantly sandy loam or loamy sand but is loam in severely eroded areas. Some pedons have an E horizon. This horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. It is sandy loam. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is sandy clay loam, sandy loam, or the gravelly analogs of these textures. The 2C horizon is gravelly loamy coarse sand, sand, or gravelly coarse sand.

Brookston Series

The Brookston series consists of deep, very poorly drained, moderately permeable soils in depressions on moraines. These soils formed in glacial till. Slopes range from 0 to 2 percent.

Brookston soils are similar to Mermill, Pewamo, and Rensselaer soils and are adjacent to Crosier, Miami, Riddles, and Wawasee soils. Mermill soils have more clay in the lower part of the solum and in the underlying material than the Brookston soils. Pewamo soils have more clay and less sand in the subsoil and in the underlying material than the Brookston soils. Rensselaer soils are stratified in the lower part of the subsoil and in the underlying material. The somewhat poorly drained Crosier and well drained Miami, Riddles, and Wawasee soils are in the higher positions on the landscape. They do not have a thick, dark surface layer and have a subsoil that is browner than that of the Brookston soils.

Typical pedon of Brookston loam, in a cultivated field; 275 feet east and 325 feet south of the northwest corner of sec. 29, T. 33 N., R. 8 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

A—9 to 17 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; few fine roots; neutral; clear wavy boundary.

Btg1—17 to 21 inches; dark gray (10YR 4/1) clay loam; common fine distinct dark brown (10YR 4/3) mottles; moderate fine subangular blocky structure; firm; few fine roots; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; thin continuous very dark gray (10YR 3/1) organic coatings on faces of peds; few glacial pebbles; neutral; clear wavy boundary.

Btg2—21 to 29 inches; grayish brown (2.5Y 5/2) clay loam; many fine distinct olive brown (2.5Y 4/4) mottles; moderate coarse subangular blocky structure; firm; few fine roots; thin continuous dark grayish brown (10YR 4/2) and grayish brown (2.5Y 5/2) clay films on faces of peds; few glacial pebbles; neutral; clear wavy boundary.

Btg3—29 to 40 inches; gray (10YR 5/1) clay loam; many fine distinct yellowish brown (10YR 5/4) mottles; moderate coarse subangular blocky structure; firm; few fine roots; thin continuous dark grayish brown (10YR 4/2) clay films on faces of peds; few glacial pebbles; neutral; clear wavy boundary.

Btg4—40 to 48 inches; grayish brown (10YR 5/2) clay loam; many coarse distinct yellowish brown (10YR 5/4) mottles; weak coarse subangular blocky structure; firm; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; few glacial pebbles; neutral; clear wavy boundary.

Bt—48 to 53 inches; dark grayish brown (10YR 4/2) clay loam; many coarse distinct yellowish brown (10YR 5/4) mottles; weak coarse subangular blocky structure; firm; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; few glacial pebbles; neutral; clear wavy boundary.

C—53 to 60 inches; brown (10YR 5/3) loam; few medium faint grayish brown (10YR 5/2) mottles; massive; firm; few glacial pebbles; strong effervescence; moderately alkaline.

The solum is 40 to 60 inches thick. Reaction is neutral or slightly acid in the A and Btg horizons and neutral to moderately alkaline in the BC horizon.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is dominantly silt loam or loam but in some pedons is silty clay loam or clay loam. The Btg horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 6. It is dominantly clay loam but in some pedons has layers of silty clay loam. Some pedons have a BC horizon. This horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 6 and is mottled. It is loam. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 4.

Coesse Series

The Coesse series consists of deep, very poorly drained, moderately slowly permeable soils in deep depressions and in glacial lakebeds on till plains and moraines. These soils formed in silty alluvial material and in the underlying clayey and loamy material. Slopes range from 0 to 2 percent.

Coesse soils are similar to Milford, Pewamo, Saranac, and Wallkill soils. Milford, Pewamo, and Saranac soils do not have a recent deposit of lighter colored, silty alluvium. Wallkill soils are underlain by muck.

Typical pedon of Coesse silty clay loam, in a cultivated field; 800 feet west and 2,500 feet south of the northeast corner of sec. 11, T. 31 N., R. 8 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silty clay loam, light brownish gray (10YR 6/2) dry; moderate fine granular structure; firm; common fine roots; neutral; abrupt smooth boundary.

Cg—8 to 22 inches; dark grayish brown (10YR 4/2) silty clay loam; common fine faint dark brown (10YR 4/3) mottles; strong medium subangular blocky structure; firm; few fine roots; neutral; clear wavy boundary.

2Ab1—22 to 27 inches; very dark gray (10YR 3/1) silty clay, gray (N 5/0) dry; common medium prominent light olive brown (2.5Y 5/6) mottles; strong medium subangular blocky structure; very firm; few fine roots; neutral; abrupt smooth boundary.

2Ab2—27 to 34 inches; very dark gray (10YR 3/1) silty clay, gray (N 5/0) dry; common fine and medium prominent light olive brown (2.5Y 5/6) mottles; strong coarse subangular blocky structure; very firm; few fine roots; dark grayish brown (2.5Y 4/2) deposits in root channels; neutral; clear wavy boundary.

2Bgb1—34 to 41 inches; dark grayish brown (2.5Y 4/2) silty clay; common medium prominent strong brown (7.5YR 5/6) mottles; moderate coarse subangular blocky structure; very firm; many thin continuous dark gray (N 4/0) clay films on faces of peds; neutral; clear wavy boundary.

2Bgb2—41 to 47 inches; dark grayish brown (2.5Y 4/2) silty clay; common medium prominent strong brown (7.5YR 5/6) mottles; weak coarse subangular blocky structure; very firm; many thin continuous dark gray (N 4/0) clay films on faces of peds; neutral; clear wavy boundary.

2Bgb3—47 to 55 inches; grayish brown (2.5Y 5/2) silty clay; common medium distinct light olive brown (2.5Y 5/6) mottles; moderate coarse subangular blocky structure; very firm; common thin patchy dark gray (N 4/0) clay films on faces of peds; neutral; clear wavy boundary.

2BCgb—55 to 70 inches; olive brown (2.5Y 4/4) clay loam; many medium and coarse faint light olive brown (2.5Y 5/6) mottles; moderate coarse subangular blocky structure; very firm; common thin patchy grayish brown (2.5Y 5/2) clay films on faces of peds; neutral; abrupt wavy boundary.

2Cg—70 to 80 inches; olive brown (2.5Y 4/4) clay loam; many medium faint light olive brown (2.5Y 5/6) and common medium distinct grayish brown (2.5Y 5/2) mottles; massive; very firm; slight effervescence; mildly alkaline.

The alluvium is 20 to 40 inches deep over the buried soil. The solum of the buried soil is 40 to 60 inches thick. The content of clay in the 10- to 40-inch control section is 35 to 40 percent. The alluvium and the buried soil are slightly acid to mildly alkaline.

The A horizon has value of 4 or 5 and chroma of 2 or 3. The Cg horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. The 2Ab horizon has value of 2 or 3 and chroma of 1 or 2. It is clay or silty clay. The 2Bgb horizon also is clay or silty clay. It has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 2 or less. The 2BCgb and 2Cg horizons have hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4. They are clay loam or silty clay loam.

Crosier Series

The Crosier series consists of deep, somewhat poorly drained, moderately slowly permeable soils on moraines. These soils formed in dense glacial till. Slopes range from 0 to 3 percent.

Crosier soils are similar to Haskins and Whitaker soils and are adjacent to Brookston, Miami, Riddles, and Wawasee soils. Haskins soils have more clay and less sand in the lower part of the subsoil and in the underlying material than the Crosier soils. Whitaker soils are stratified in the lower part of the subsoil and in the underlying material. Brookston soils have a surface layer that is thicker and darker than that of the Crosier soils and are dominantly grayish in the subsoil. They are very poorly drained and are in depressions and drainageways. Miami, Riddles, and Wawasee soils have fewer mottles in the subsoil than the Crosier soils. They are well drained and are in the higher positions on the landscape.

Typical pedon of Crosier sandy loam, 0 to 3 percent slopes, in a cultivated field; 425 feet south and 450 feet east of the northwest corner of sec. 29, T. 33 N., R. 8 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) sandy loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; common fine roots; neutral; abrupt smooth boundary.

Bt1—8 to 11 inches; light brownish gray (10YR 6/2) loam; many fine and medium distinct yellowish brown (10YR 5/4) and pale brown (10YR 6/3) mottles; moderate medium platy structure parting to moderate very fine subangular blocky; friable; few fine roots; thin discontinuous dark grayish brown (10YR 4/2) clay films in root channels; slightly acid; clear wavy boundary.

Bt2—11 to 16 inches; light olive brown (2.5Y 5/4) clay loam; common fine distinct light brownish gray (10YR 6/2) and light olive brown (2.5Y 5/6) mottles; weak medium prismatic structure parting to moderate coarse subangular blocky; firm; few fine roots; thin continuous grayish brown (10YR 5/2) clay films on faces of peds; few glacial pebbles; neutral; clear wavy boundary.

Bt3—16 to 22 inches; olive brown (2.5Y 4/4) clay loam; common medium prominent light brownish gray (10YR 6/2) and light olive brown (2.5Y 5/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; thin discontinuous grayish brown (10YR 5/2) clay films on faces of peds; few glacial pebbles; neutral; clear wavy boundary.

BC—22 to 25 inches; light olive brown (2.5Y 5/4) loam; common medium distinct light brownish gray (10YR 6/2) and light olive brown (2.5Y 5/6) mottles; weak coarse prismatic structure; firm; few fine roots; thin patchy grayish brown (10YR 5/2) clay films on faces of peds; few glacial pebbles; neutral; clear wavy boundary.

C—25 to 60 inches; light olive brown (2.5Y 5/4) sandy loam; common medium distinct light brownish gray (10YR 6/2), pale brown (10YR 6/3), and yellowish brown (10YR 5/6) mottles; massive; firm; thin discontinuous light gray (10YR 7/2) calcium carbonate deposits in vertical cracks; few glacial pebbles; strong effervescence; moderately alkaline.

The solum is 24 to 40 inches thick. Reaction is neutral to medium acid in the A, E, and Bt horizons and neutral to moderately alkaline in the BC horizon.

The Ap horizon has chroma of 2 or 3. Pedons in areas that have not been cultivated have an A horizon. This horizon has hue of 10YR and value of 3. The Ap or A horizon is dominantly sandy loam or loam but in some pedons is silt loam. Some pedons have an E horizon. This horizon has hue of 10YR, value of 5 or 6, chroma of 1 to 6 and is mottled. It is dominantly sandy loam or loam but in some pedons is silt loam. The Bt horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 6. It is clay loam, loam, or sandy clay loam. The BC horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It is loam or sandy clay loam. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6, chroma of 2 to 4. It is loam or sandy loam.

Fulton Series

The Fulton series consists of deep, somewhat poorly drained, slowly permeable soils on till plains and moraines. These soils formed in stratified lacustrine deposits. Slopes range from 0 to 2 percent.

Fulton soils are similar to Blount, Haskins, and Whitaker soils and are adjacent to Glynwood and Milford soils. Blount soils are not stratified in the underlying material. Haskins and Whitaker soils have less clay and more sand in the upper part of the subsoil than the Fulton soils. Glynwood soils have fewer grayish mottles in the upper part of the subsoil than the Fulton soils. They are moderately well drained and are in the more sloping areas. Milford soils have a surface layer that is thicker and darker than that of the Fulton soils and are dominantly grayish in the subsoil. They are very poorly drained and are in depressions.

Typical pedon of Fulton silty clay loam, in a cultivated field; 1,880 feet north and 200 feet west of the center of sec. 32, T. 32 N., R. 8 E.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) silty clay loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; few fine roots; medium acid; abrupt smooth boundary.

Bt1—10 to 16 inches; dark brown (10YR 4/3) clay; many fine faint dark grayish brown (10YR 4/2) mottles; moderate fine subangular blocky structure; firm; few fine roots; thin continuous dark grayish brown (10YR 4/2) clay films on faces of peds; medium acid; clear wavy boundary.

Bt2—16 to 25 inches; brown (10YR 5/3) silty clay; many fine faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin continuous dark grayish brown (10YR 4/2) clay films on faces of peds; neutral; clear wavy boundary.

BC—25 to 32 inches; brown (10YR 5/3) silty clay; common fine faint grayish brown (10YR 5/2) mottles; moderate coarse angular blocky structure; firm; few fine roots; thin continuous dark grayish brown (10YR 4/2) clay films on vertical faces of peds; thin patchy gray (10YR 5/1) silt coatings on vertical faces of peds; strong effervescence; moderately alkaline; gradual smooth boundary.

C1—32 to 54 inches; brown (10YR 5/3) silty clay; common medium faint grayish brown (10YR 5/2) mottles; massive; firm; thin patchy dark grayish brown (10YR 4/2) clay films on vertical faces of fracture planes, decreasing in number with increasing depth; thin continuous gray (10YR 5/1) silt coatings on fracture planes; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—54 to 60 inches; brown (10YR 5/3) stratified silty clay loam, silt loam, and loamy fine sand; many medium distinct gray (10YR 5/1) mottles; massive; friable; thin continuous gray (10YR 5/1) silt coatings on fracture planes; strong effervescence; moderately alkaline.

The solum is 24 to 40 inches thick. The Ap horizon has chroma of 1 or 2. Pedons in undisturbed areas have an A horizon, which has value of 3. The Ap or A horizon is dominantly silty clay loam or silt loam but in some pedons is loam. It is neutral to medium acid. Some pedons have an E horizon. This horizon has hue of 10YR, value of 5 or 6, and chroma of 1 or 2 and is mottled. It is dominantly silt loam but in some pedons is loam. It is neutral to strongly acid. The Bt horizon also is neutral to strongly acid. It has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 4. The BC horizon has value of 4 or 5 and chroma of 1 to 4. It is silty clay, silty clay loam, or silt loam. It is neutral to moderately alkaline. The C horizon has value of 5 or 6 and chroma of 2 to 6. It is stratified silty clay to fine sand.

Glynwood Series

The Glynwood series consists of deep, moderately well drained, slowly permeable soils on moraines and till plains. These soils formed in dense glacial till. Slopes range from 3 to 8 percent.

Glynwood soils are similar to Morley and Rawson soils and are adjacent to Blount, Fulton, and Pewamo soils. Morley soils have fewer grayish mottles in the subsoil than the Glynwood soils. Rawson soils have more sand and less clay in the upper part of the subsoil than the Glynwood soils. The somewhat poorly drained Blount and Fulton and very poorly drained Pewamo soils are on foot slopes, in the less sloping areas, and in depressions. They have a greater number of grayish mottles in the upper part of the subsoil than the Glynwood soils.

Typical pedon of Glynwood loam, 3 to 6 percent slopes, eroded, in a cultivated field; 825 feet north and 2,025 feet east of the southwest corner of sec. 10, T. 30 N., R. 8 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; mixed with dark yellowish brown (10YR 4/4) clay loam; weak coarse granular structure; friable; few fine roots; few glacial pebbles; slightly acid; abrupt smooth boundary.

Bt1—8 to 13 inches; dark yellowish brown (10YR 4/4) clay; moderate medium subangular blocky structure; firm; few fine roots; thin discontinuous dark grayish brown (10YR 4/2) clay films on faces of peds; few glacial pebbles; neutral; clear wavy boundary.

Bt2—13 to 16 inches; dark yellowish brown (10YR 4/4) clay; few medium distinct light brownish gray (10YR 6/2) and yellowish brown (10YR 5/6) mottles; moderate coarse subangular blocky structure; firm; few fine roots; thin discontinuous dark grayish brown

(10YR 4/2) clay films on faces of peds; few glacial pebbles; neutral; clear wavy boundary.

Bt3—16 to 19 inches; dark yellowish brown (10YR 4/4) clay; common medium distinct light brownish gray (10YR 6/2) and yellowish brown (10YR 5/6) mottles; moderate coarse subangular blocky structure; firm; few fine roots; thin discontinuous dark grayish brown (10YR 4/2) clay films on faces of peds; few glacial pebbles; neutral; clear wavy boundary.

BC—19 to 22 inches; dark yellowish brown (10YR 4/4) clay; common medium distinct light brownish gray (10YR 6/2) and yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; few fine roots; thin discontinuous dark grayish brown (10YR 4/2) clay films on faces of peds; few glacial pebbles; slight effervescence; mildly alkaline; clear wavy boundary.

C—22 to 60 inches; brown (10YR 5/3) clay loam; many fine faint grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) mottles; massive; very firm; medium continuous light gray (10YR 7/2) calcium carbonate deposits in vertical cracks; few glacial pebbles; strong effervescence; moderately alkaline.

The solum is 16 to 36 inches thick. Reaction is neutral to medium acid in the A, E, and Bt horizons and slightly acid to moderately alkaline in the BC horizon.

The Ap horizon has value of 4 or 5 and chroma of 2 to 4. Pedons in undisturbed areas have an A horizon, which has hue of 10YR, value of 3, and chroma of 1 or 2. The Ap or A horizon is dominantly silt loam or loam but in severely eroded areas is clay loam or silty clay loam. Some pedons have an E horizon. This horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. It is silt loam or loam. The Bt horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 6. It is clay, clay loam, silty clay loam, or silty clay. The BC horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 or 4. It is clay, clay loam, or silty clay loam. The C horizon has hue of 10YR or 2.5Y and chroma of 3 or 4. It is clay loam or silty clay loam.

Granby Series

The Granby series consists of deep, very poorly drained, rapidly permeable soils in depressions on outwash plains. These soils formed in stratified, sandy glacial outwash. Slopes range from 0 to 2 percent.

Granby soils are adjacent to Adrian, Houghton, and Mermill soils. Adrian and Houghton soils formed in organic material. They are in the lowest part of the depressions. Mermill soils have more clay throughout than the Granby soils. They are in the slightly higher positions on the landscape.

Typical pedon of Granby loamy sand, in a cultivated field; 275 feet north and 750 feet west of the southeast corner of sec. 3, T. 32 N., R. 8 E.

Ap—0 to 11 inches; black (10YR 2/1) loamy sand, dark gray (10YR 4/1) dry; weak medium granular structure; friable; common fine roots; neutral; abrupt smooth boundary.

Bg1—11 to 21 inches; light gray (10YR 6/1) loamy sand; few fine faint pale brown (10YR 6/3) mottles; weak fine subangular blocky structure; very friable; few fine roots; about 8 percent gravel; neutral; clear irregular boundary.

Bg2—21 to 32 inches; light brownish gray (10YR 6/2) sand; few fine faint pale brown (10YR 6/3) mottles; single grain; loose; few fine roots; about 7 percent gravel; neutral; clear irregular boundary.

Cg1—32 to 38 inches; light gray (10YR 6/1) gravelly sand; single grain; loose; about 17 percent gravel; strong effervescence; moderately alkaline; clear irregular boundary.

Cg2—38 to 60 inches; pale brown (10YR 6/3) sand; single grain; loose; about 12 percent gravel; strong effervescence; moderately alkaline.

The solum is 24 to 52 inches thick. The A horizon has value of 2 or 3 and chroma of 1 or 2. It is loamy sand, loamy fine sand, or fine sand. It is medium acid to mildly alkaline. The B horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 3. It is loamy sand, loamy fine sand, fine sand, or sand. It is slightly acid to mildly alkaline. The C horizon has hue of 10YR or 2.5Y, value of 5 to 7, and chroma of 1 to 4. It is loamy sand, sand, or gravelly sand.

Haskins Series

The Haskins series consists of deep, somewhat poorly drained soils on till plains and moraines. These soils formed in loamy glacial outwash and in the underlying dense glacial till. They are moderately permeable in the upper part of the solum and slowly permeable in the lower part and in the underlying material. Slopes range from 0 to 3 percent.

Haskins soils are similar to Blount, Crosier, Fulton, and Whitaker soils and are commonly adjacent to Mermill, Pewamo, and Rawson soils. Blount and Fulton soils have less sand and more clay in the upper part of the subsoil than the Haskins soils. Crosier and Whitaker soils have less clay and more sand in the lower part of the subsoil and in the underlying material than the Haskins soils. Mermill and Pewamo soils have a surface layer that is thicker and darker than that of the Haskins soils and are dominantly grayish in the subsoil. They are very poorly drained and are in depressions and drainageways. Rawson soils have fewer grayish mottles in the upper part of the subsoil than the Haskins soils. They are moderately well drained and are in the more sloping areas.

Typical pedon of Haskins loam, 0 to 3 percent slopes, in a cultivated field; 1,800 feet north and 75 feet west of the southeast corner of sec. 8, T. 30 N., R. 8 E.

Ap—0 to 11 inches; dark grayish brown (10YR 4/2) loam, pale brown (10YR 6/3) dry; weak fine granular structure; friable; few fine roots; neutral; abrupt smooth boundary.

Btg—11 to 16 inches; grayish brown (10YR 5/2) clay loam; common medium distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin continuous dark grayish brown (10YR 4/2) clay films on faces of peds; thin continuous grayish brown (10YR 5/2) silt coatings on vertical faces of peds; medium acid; clear wavy boundary.

Bt1—16 to 27 inches; yellowish brown (10YR 5/6) clay loam; common fine distinct grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; firm; few fine roots; thin continuous dark grayish brown (10YR 4/2) clay films on faces of peds; slightly acid; abrupt wavy boundary.

2Bt2—27 to 33 inches; dark brown (10YR 4/3) clay loam; common medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin continuous dark grayish brown (10YR 4/2) clay films on faces of peds; few glacial pebbles; slightly acid; clear wavy boundary.

2Bt3—33 to 37 inches; brown (10YR 5/3) clay loam; common medium distinct grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; firm; few fine roots; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; few glacial pebbles; neutral; gradual smooth boundary.

2C—37 to 60 inches; brown (10YR 5/3) silty clay loam; many fine faint grayish brown (10YR 5/2) mottles; massive; very firm; thin patchy gray (10YR 6/1) calcium carbonate coatings in cracks; few glacial pebbles; strong effervescence; about 27 percent masses of calcium carbonate; moderately alkaline.

The solum is 28 to 50 inches thick. The Ap horizon has value of 4 or 5 and chroma of 1 or 2. Pedons in undisturbed areas have an A horizon, which has value of 3. The Ap or A horizon is loam or sandy loam. It is neutral to medium acid. Some pedons have an E horizon. This horizon has hue of 10YR, value of 5 or 6, and chroma of 2 or 3. It is loam or sandy loam. It is slightly acid to strongly acid. The Bt and 2Bt horizons have hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 6. The Bt horizon is loam, sandy loam, sandy clay loam, clay loam, or the gravelly analogs of these textures. The 2Bt horizon is clay, clay loam, or silty clay loam. It is neutral to medium acid. Some pedons have a 2BC horizon. This horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is clay loam or silty clay loam. It is neutral or mildly alkaline. The 2C horizon has chroma of 3 or 4. It is clay loam or silty clay loam.

Hennepin Series

The Hennepin series consists of deep, well drained, slowly permeable soils on sharp breaks and on the sides of deeply incised drainageways. These soils formed in dense glacial till. Slopes range from 25 to 50 percent.

Hennepin soils are adjacent to Miami, Morley, and Shoals soils. Miami and Morley soils have a solum that is thicker than that of the Hennepin soils. They are in the less sloping areas. The somewhat poorly drained Shoals soils are on narrow bottom land. They are grayish directly below the surface soil.

Typical pedon of Hennepin loam, 25 to 50 percent slopes, in a woodlot; 2,120 feet south and 1,500 feet west of the northeast corner of sec. 19, T. 32 N., R. 8 E.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) loam, light brownish gray (10YR 6/2) dry; moderate fine granular structure; friable; many fine and medium roots; few glacial pebbles; neutral; clear wavy boundary.

Bw1—3 to 9 inches; dark yellowish brown (10YR 4/4) clay loam; moderate fine subangular blocky structure; firm; common fine and medium roots; thin continuous very dark grayish brown (10YR 3/2) coatings in old root channels; few glacial pebbles; neutral; clear wavy boundary.

Bw2—9 to 18 inches; brown (10YR 4/3) clay loam; moderate fine subangular blocky structure; firm; common fine and medium roots; few glacial pebbles; slight effervescence; mildly alkaline; gradual wavy boundary.

C—18 to 60 inches; yellowish brown (10YR 5/4) clay loam; massive; firm; few fine roots; few glacial pebbles; strong effervescence; moderately alkaline.

The solum is 8 to 20 inches thick. It is neutral or mildly alkaline.

The A horizon has value of 3 or 4 and chroma of 2 or 3. It is loam, silt loam, or clay loam. The Bw and C horizons have value of 4 or 5 and chroma of 3 or 4. They are loam or clay loam.

Homer Series

The Homer series consists of deep, somewhat poorly drained soils on terraces and outwash plains. These soils formed in loamy outwash over sand and gravel. They are moderately permeable in the solum and very rapidly permeable in the underlying material. Slopes range from 0 to 2 percent.

Homer soils are similar to Whitaker soils and are adjacent to Boyer, Kalamazoo, and Sebewa soils.

Whitaker soils have a solum that is thicker than that of the Homer soils and have less gravel throughout. Boyer and Kalamazoo soils are well drained and are in the higher areas. They do not have mottles in the upper part of the subsoil. The very poorly drained Sebewa soils are in depressions. They have a surface layer that is thicker and darker than that of the Homer soils and are dominantly grayish in the subsoil.

Typical pedon of Homer loam, in a cultivated field; 1,450 feet south and 2,500 feet east of the northwest corner of sec. 3, T. 30 N., R. 8 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; few fine roots; slightly acid; abrupt smooth boundary.

Btg—8 to 14 inches; dark grayish brown (10YR 4/2) sandy clay loam; many fine distinct dark yellowish brown (10YR 4/4) and strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; friable; few fine roots; thin discontinuous dark grayish brown (10YR 4/2) clay films on faces of peds; about 10 percent gravel; slightly acid; clear wavy boundary.

2Bt1—14 to 26 inches; strong brown (7.5YR 5/6) gravelly sandy clay loam; many medium distinct dark grayish brown (10YR 4/2) and yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin continuous dark grayish brown (10YR 4/2) clay films on faces of peds; about 17 percent gravel; slightly acid; clear wavy boundary.

2Bt2—26 to 31 inches; yellowish brown (10YR 5/6) gravelly sandy clay loam; many fine distinct dark grayish brown (10YR 4/2) mottles; weak coarse subangular blocky structure; friable; few fine roots; thin discontinuous dark grayish brown (10YR 4/2) clay films on faces of peds; about 20 percent gravel; neutral; clear wavy boundary.

2BC—31 to 36 inches; dark grayish brown (10YR 4/2) gravelly sandy clay loam; common fine faint dark brown (10YR 4/3) mottles; single grain; very friable; dark grayish brown (10YR 4/2) clay bridges between sand grains; about 26 percent gravel; slight effervescence; mildly alkaline; abrupt wavy boundary.

3C1—36 to 47 inches; dark grayish brown (10YR 4/2) gravelly loamy coarse sand; single grain; loose; about 25 percent gravel; strong effervescence; moderately alkaline; abrupt smooth boundary.

3C2—47 to 55 inches; gray (10YR 5/1) sand; single grain; loose; about 12 percent gravel; strong effervescence; moderately alkaline; abrupt smooth boundary.

3C3—55 to 60 inches; gray (10YR 5/1) gravelly coarse sand; single grain; about 25 percent gravel; strong effervescence; moderately alkaline.

The solum is 24 to 40 inches thick. Reaction is neutral to medium acid in the A, E, Bt, and 2Bt horizons and slightly acid to mildly alkaline in the 2BC horizon.

The A horizon has value of 3 or 4 and chroma of 2 or 3. It is sandy loam or loam. Some pedons have an E horizon. This horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3 and is mottled in some pedons. It is sandy loam or loam. The Bt and 2Bt horizons have hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 6. The Bt horizon is sandy loam, sandy clay loam, or clay loam, and the 2Bt horizon is the gravelly analogs of these textures. The 3C horizon has value of 4 or 5 and chroma of 1 to 3.

Houghton Series

The Houghton series consists of deep, very poorly drained, moderately slowly permeable to moderately rapidly permeable soils in deep depressions on moraines and outwash plains. These soils formed in thick deposits of organic material. Slopes range from 0 to 2 percent.

Houghton soils are similar to Adrian, Boots, Martisco, Muskego, and Palms soils and are adjacent to Granby, Mermill, Milford, Pewamo, Rensselaer, and Saranac soils. Adrian, Martisco, Muskego, and Palms soils have a layer of sapric material that is thinner than that of the Houghton soils. They are underlain by sandy and loamy material, marl, or coprogenous earth. Boots soils have more fibers in the subsurface and bottom tiers than the Houghton soils. Granby, Mermill, Milford, Pewamo, Rensselaer, and Saranac are mineral soils on the slightly higher rises or edges of the depressions and on alluvial fans.

Typical pedon of Houghton muck, drained, in a cultivated field; 1,160 feet south and 100 feet east of the center of sec. 8, T. 32 N., R. 8 E.

Op—0 to 10 inches; sapric material, black (10YR 2/1) broken face, pressed, and rubbed; about 2 percent fiber, a trace rubbed; moderate fine granular structure; very friable; common fine roots; herbaceous fibers; about 20 percent mineral material; neutral; abrupt smooth boundary.

Oa1—10 to 16 inches; sapric material, black (10YR 2/1) broken face, dark reddish brown (5YR 2/2) pressed and rubbed; about 4 percent fiber, a trace rubbed; weak coarse subangular blocky structure; friable; common fine roots; herbaceous fibers; about 15 percent mineral material; neutral; clear wavy boundary.

Oa2—16 to 22 inches; sapric material, dark reddish brown (5YR 2/2) broken face, black (10YR 2/1) pressed and rubbed; about 10 percent fiber, 4 percent rubbed; massive; friable; few fine roots; herbaceous fibers; about 10 percent mineral material; neutral; clear smooth boundary.

Oa3—22 to 30 inches; sapric material, black (10YR 2/1) broken face, pressed, and rubbed; about 17 percent fiber, 2 percent rubbed; massive; friable; few fine roots; herbaceous fibers; about 10 percent mineral material; neutral; clear smooth boundary.

Oa4—30 to 41 inches; sapric material, black (10YR 2/1) broken face, pressed, and rubbed; about 30 percent fiber, 7 percent rubbed; massive; friable; herbaceous fibers; about 5 percent mineral material; slightly acid; clear wavy boundary.

Oa5—41 to 49 inches; sapric material, black (10YR 2/1) broken face, pressed, and rubbed; about 15 percent fiber, 5 percent rubbed; massive; friable; herbaceous fibers; about 5 percent mineral material; slightly acid; clear smooth boundary.

Oa6—49 to 60 inches; sapric material, black (10YR 2/1) broken face, pressed, and rubbed; about 25 percent fiber, 10 percent rubbed; massive; friable; herbaceous fibers; about 5 percent mineral material; slightly acid.

The organic material is more than 51 inches thick. The fiber is derived primarily from herbaceous plants.

The organic material has hue of 10YR to 5YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 3. It is medium acid to mildly alkaline. It is dominantly sapric material but has some thin layers of hemic material. The layers of hemic material are 2 to 6 inches thick and have a combined thickness of less than 10 inches.

Kalamazoo Series

The Kalamazoo series consists of deep, well drained soils on river terraces, outwash plains, and moraines. These soils formed in loamy, sandy, and gravelly glacial outwash. They are moderately permeable in the upper part of the solum and rapidly permeable in the lower part and in the underlying material. Slopes range from 0 to 6 percent.

Kalamazoo soils are similar to Boyer, Martinsville, Ormas, and Oshtemo soils and are commonly adjacent to Homer and Sebewa soils. Boyer soils have a solum that is thinner than that of the Kalamazoo soils. Martinsville soils have less sand and gravel in the substratum than the Kalamazoo soils. Ormas soils have a surface layer that is more sandy than that of the Kalamazoo soils. Oshtemo soils have less clay in the upper part of the solum than the Kalamazoo soils. The somewhat poorly drained Homer and very poorly drained Sebewa soils are in the lower areas and in depressions. Their subsoil is grayer than that of the Kalamazoo soils.

Typical pedon of Kalamazoo sandy loam, 0 to 2 percent slopes, in a cultivated field; 180 feet west and 1,880 feet north of the southeast corner of sec. 5, T. 30 N., R. 8 E.

Ap—0 to 9 inches; dark brown (10YR 4/3) sandy loam, pale brown (10YR 6/3) dry; moderate medium granular structure; friable; few fine roots; about 6 percent gravel; medium acid; abrupt smooth boundary.

Bt1—9 to 13 inches; brown (7.5YR 4/4) sandy loam; moderate fine subangular blocky structure; firm; few fine roots; thin continuous dark brown (7.5YR 4/4) clay films on faces of peds; about 4 percent gravel; medium acid; clear wavy boundary.

2Bt2—13 to 24 inches; brown (7.5YR 4/4) gravelly sandy clay loam; moderate fine subangular blocky structure; firm; few fine roots; thin continuous dark brown (7.5YR 4/4) clay films on faces of peds; about 20 percent gravel; medium acid; clear wavy boundary.

2Bt3—24 to 34 inches; dark brown (7.5YR 4/4) gravelly sandy clay loam; weak fine subangular blocky structure; friable; thin continuous dark reddish brown (5YR 3/4) clay films on faces of peds; about 18 percent gravel; medium acid; clear wavy boundary.

2Bt4—34 to 43 inches; dark brown (7.5YR 4/4) gravelly sandy loam; weak coarse subangular blocky structure; friable; thin patchy dark yellowish brown (10YR 3/4) clay films on faces of peds; about 18 percent gravel; medium acid; clear wavy boundary.

2Bt5—43 to 47 inches; dark brown (7.5YR 4/4) gravelly sandy loam; weak coarse subangular blocky structure; friable; thin continuous dark reddish brown (5YR 3/4) clay films on faces of peds; about 20 percent gravel; slightly acid; clear irregular boundary.

2C—47 to 60 inches; pale brown (10YR 6/3) gravelly coarse sand; single grain; loose; about 30 percent gravel; strong effervescence; moderately alkaline.

The solum is 40 to 72 inches thick. Reaction is strongly acid to neutral in the A, E, and Bt horizons and mildly alkaline or moderately alkaline in the C horizon.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. It is loam or sandy loam. Some pedons have an E horizon. This horizon has hue of 10YR, value or 4 or 5, and chroma of 3. It is loam or sandy loam. The Bt horizon has hue of 10YR, 7.5YR, or 5YR and value and chroma of 3 or 4. It is sandy clay loam, clay loam, sandy loam, or the gravelly analogs of these textures. The C horizon has value of 5 or 6 and chroma of 3 or 4. It is sand or gravelly coarse sand.

Martinsville Series

The Martinsville series consists of deep, well drained, moderately permeable soils on river terraces, outwash plains, and moraines. These soils formed in loamy and sandy glacial outwash. Slopes range from 1 to 15 percent.

Martinsville soils are similar to Kalamazoo and Riddles soils and are commonly adjacent to Rensselaer and

Whitaker soils. Kalamazoo soils have more gravel in the subsoil and underlying material than the Martinsville soils. Riddles soils are underlain by glacial till. The very poorly drained Rensselaer and somewhat poorly drained Whitaker soils are in the lower areas and in depressions. They are grayer in the subsoil than the Martinsville soils.

Typical pedon of Martinsville loam, 1 to 6 percent slopes, in a cultivated field; 600 feet west and 175 feet north of the center of sec. 36, T. 32 N., R. 10 E.

Ap—0 to 10 inches; dark brown (10YR 4/3) loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

Bt1—10 to 15 inches; dark brown (7.5YR 4/4) sandy clay loam; moderate medium subangular blocky structure; friable; few fine roots; thin patchy dark yellowish brown (10YR 3/4) clay films on faces of peds; slightly acid; clear wavy boundary.

Bt2—15 to 27 inches; dark brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few fine roots; thin continuous dark yellowish brown (10YR 3/4) clay films on faces of peds; medium acid; abrupt smooth boundary.

Bt3—27 to 31 inches; dark yellowish brown (10YR 4/4) clay loam; weak coarse subangular blocky structure; firm; few fine roots; thin patchy dark yellowish brown (10YR 4/4) clay films on faces of peds; medium acid; abrupt smooth boundary.

Bt4—31 to 36 inches; dark brown (7.5YR 4/4) clay loam; weak coarse subangular blocky structure; firm; few fine roots; thin patchy dark yellowish brown (10YR 4/4) clay films on faces of peds; medium acid; clear wavy boundary.

Bt5—36 to 45 inches; dark brown (7.5YR 4/4) sandy clay loam; weak fine subangular blocky structure; firm; thin patchy dark yellowish brown (10YR 3/4) clay films on faces of peds; about 10 percent gravel; medium acid; clear wavy boundary.

Bt6—45 to 50 inches; yellowish brown (10YR 5/4) loam; weak coarse subangular blocky structure; friable; thin patchy dark yellowish brown (10YR 4/4) clay films on faces of peds; slightly acid; clear smooth boundary.

C—50 to 60 inches; brown (10YR 5/3) stratified loamy fine sand, fine sand, and sand; single grain; loose; strong effervescence; moderately alkaline.

The solum is 40 to 60 inches thick. The A horizon has value of 3 or 4 and chroma of 2 to 4. It is loam, sandy loam, or silt loam. It is neutral to medium acid. Some pedons have an E horizon. This horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 or 4. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is clay loam, sandy clay loam, silty clay loam, loam, or sandy loam. It is slightly acid to strongly acid. The C horizon has value of 5 or 6 and chroma of 2 to 4. It is stratified silt loam to sand. It is neutral to moderately alkaline.

Martisco Series

The Martisco series consists of deep, very poorly drained, slowly permeable to moderately permeable soils in deep depressions on outwash plains, terraces, and old lake beaches. These soils formed in organic material over marl. Slopes range from 0 to 2 percent.

The Martisco soils in this county contain more sand in the marl than is definitive for the series. This difference, however, does not alter the usefulness or behavior of the soils.

Martisco soils are similar to Adrian, Houghton, Muskego, and Palms soils and are commonly adjacent to Milford and Rensselaer soils. Adrian and Palms soils are underlain by sandy or loamy material. Houghton soils have a layer of muck that is thicker than that of the Martisco soils and are not underlain by marl. Muskego soils are underlain by coprogenous earth. Milford and Rensselaer are mineral soils. They are on slight rises and the higher edges of the depressions.

Typical pedon of Martisco muck, drained, in a cultivated field; 125 feet south and 1,960 feet east of the northwest corner of sec. 23, T. 31 N., R. 8 E.

Op—0 to 12 inches; sapric material, black (10YR 2/1) broken face, rubbed, and pressed; about 2 percent fiber, a trace rubbed; weak fine granular structure; very friable; few fine roots; herbaceous fibers; about 40 percent mineral material; neutral; abrupt smooth boundary.

C1—12 to 18 inches; white (2.5Y 8/2) marl; common medium prominent strong brown (7.5YR 5/6) mottles; moderate medium platy structure; friable; few fine roots; common shells; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—18 to 35 inches; light brownish gray (2.5Y 6/2) marl; common medium distinct strong brown (7.5YR 5/6) mottles; weak medium platy structure; friable; few fine roots; many shells; strong effervescence; moderately alkaline; clear wavy boundary.

C3—35 to 48 inches; grayish brown (2.5Y 5/2) marl; common coarse distinct strong brown (7.5YR 5/6) mottles; massive; friable; many shells; strong effervescence; moderately alkaline; clear wavy boundary.

C4—48 to 58 inches; light brownish gray (2.5Y 6/2) marl; many medium distinct gray (5Y 5/1) and strong brown (7.5YR 5/6) mottles; massive; friable; common shells; strong effervescence; moderately alkaline; abrupt smooth boundary.

C5—58 to 60 inches; dark gray (5Y 4/1) marl; massive; friable; many shells; strong effervescence; moderately alkaline.

The organic material is 8 to 16 inches thick. The thickness of the marl ranges from 30 to 60 inches. The fiber is derived primarily from herbaceous plants.

The O horizon has hue of 10YR or 2.5Y or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. It has a mineral content of 20 to 80 percent. It ranges from slightly acid to moderately alkaline. The C horizon has hue of 10YR to 5Y or is neutral in hue. It has value of 4 to 8 and chroma of 0 to 2. It has few to many shells.

Mermill Series

The Mermill series consists of deep, very poorly drained soils in depressions and drainageways on till plains and moraines. These soils formed in loamy outwash and in the underlying glacial till. They are moderately permeable in the upper part of the solum and slowly permeable in the lower part and in the underlying material. Slopes range from 0 to 2 percent.

Mermill soils are similar to Brookston, Pewamo, and Rensselaer soils and are commonly adjacent to Granby, Haskins, Houghton, Palms, and Rawson soils. Brookston soils have less clay in the lower part of the solum and in the underlying material than the Mermill soils. Pewamo soils have more clay and less sand in the upper part of the solum than the Mermill soils. Rensselaer soils are stratified in the lower part of the subsoil and in the underlying material. Granby soils are sandier throughout than the Mermill soils. They are in the lower positions on the landscape. The somewhat poorly drained Haskins and moderately well drained Rawson soils are on the slightly higher, convex parts of the landscape. They do not have a dark surface layer and are less gray in the subsoil than the Mermill soils. Houghton and Palms soils formed in organic material in deep depressions.

Typical pedon of Mermill loam, in a cultivated field; 100 feet south and 325 feet east of the northwest corner of sec. 6, T. 30 N., R. 10 E.

Ap—0 to 9 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak medium granular structure; friable; few fine roots; slightly acid; abrupt smooth boundary.

Btg1—9 to 19 inches; dark gray (10YR 4/1) clay loam; common fine distinct dark brown (10YR 4/3) mottles; moderate fine subangular blocky structure; firm; few fine roots; thin continuous very dark gray (10YR 3/1) clay films on faces of peds; neutral; clear wavy boundary.

Btg2—19 to 31 inches; gray (10YR 5/1) clay loam; many fine distinct dark brown (10YR 4/3) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin continuous dark gray (10YR 4/1) clay films on faces of peds; thin continuous very dark gray (10YR 3/1) organic coatings on vertical faces of peds; neutral; gradual wavy boundary.

Btg3—31 to 39 inches; gray (10YR 5/1) sandy clay loam; common fine distinct light olive brown (2.5Y 5/4) mottles; weak medium prismatic structure; friable; few fine roots; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; thin continuous very dark gray (10YR 3/1) organic coatings on vertical faces of peds; neutral; abrupt wavy boundary.

2Btg4—39 to 43 inches; grayish brown (2.5Y 5/2) clay loam; many medium distinct olive brown (2.5Y 4/4) mottles; weak coarse subangular blocky structure; firm; few fine roots; thin continuous gray (N 5/0) clay films on faces of peds; thin continuous dark grayish brown (10YR 4/2) sand grains on vertical faces of peds; few glacial pebbles; neutral; clear wavy boundary.

2Btg5—43 to 51 inches; dark gray (10YR 4/1) clay loam; common fine distinct olive brown (2.5Y 4/4) mottles; weak coarse subangular blocky structure; firm; thin patchy dark gray (10YR 4/1) clay films on faces of peds; few glacial pebbles; neutral; clear wavy boundary.

2BC—51 to 56 inches; grayish brown (10YR 5/2) clay loam; common fine distinct olive brown (2.5Y 4/4) mottles; weak coarse subangular blocky structure; firm; thin patchy dark gray (10YR 4/1) clay films on faces of peds; few glacial pebbles; slight effervescence; mildly alkaline; gradual wavy boundary.

2C—56 to 60 inches; yellowish brown (10YR 5/4) clay loam; common fine distinct gray (10YR 5/1) mottles; massive; firm; few glacial pebbles; strong effervescence; moderately alkaline.

The solum ranges from 30 to 60 inches in thickness. The Ap horizon is 7 to 9 inches thick. It has value of 2 or 3 and chroma of 1 or 2. It is commonly loam or silt loam but in some pedons is clay loam, fine sandy loam, or sandy clay loam. It is slightly acid or neutral. The Btg horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is clay loam, sandy clay loam, or loam. It is medium acid to neutral. The 2Btg horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is clay, clay loam, or silty clay loam. It is neutral to moderately alkaline. The C horizon has value of 4 or 5 and chroma of 1 to 4. It is silty clay loam or clay loam.

Miami Series

The Miami series consists of deep, well drained, moderately slowly permeable soils on moraines. These soils formed in dense glacial till. Slopes range from 2 to 25 percent.

Miami soils are similar to Morley, Rawson, Riddles, and Wawasee soils and are adjacent to Brookston, Crosier, and Hennepin soils. Morley and Rawson soils have more clay in the lower part of the solum and in the underlying material than the Miami soils. Riddles soils have a solum that is thicker than that of the Miami soils.

Wawasee soils have more sand and less clay than the Miami soils. The very poorly drained Brookston and somewhat poorly drained Crosier soils are on foot slopes, in nearly level areas, and in depressions. They have mottles in the upper part of the subsoil. Hennepin soils have a solum that is thinner than that of the Miami soils. They are on steep breaks.

Typical pedon of Miami sandy loam, 2 to 6 percent slopes, eroded, in a cultivated field; 80 feet west and 1,050 feet south of the northeast corner of sec. 30, T. 33 N., R. 8 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) sandy loam, light brownish gray (10YR 6/2) dry; mixed with yellowish brown (10YR 5/4) clay loam; weak fine granular structure; friable; few fine roots; few glacial pebbles; neutral; abrupt smooth boundary.

Bt1—8 to 17 inches; yellowish brown (10YR 5/4) loam; moderate medium subangular blocky structure; firm; few fine roots; thin patchy dark yellowish brown (10YR 4/4) clay films on faces of peds; thin patchy brown (10YR 5/3) silt coatings on faces of peds; few glacial pebbles; neutral; clear wavy boundary.

Bt2—17 to 24 inches; dark yellowish brown (10YR 4/4) clay loam; strong coarse subangular blocky structure; firm; few fine roots; thin continuous dark yellowish brown (10YR 3/4) clay films on faces of peds; few glacial pebbles; slightly acid; clear wavy boundary.

Bt3—24 to 30 inches; yellowish brown (10YR 5/4) clay loam; weak coarse subangular blocky structure; firm; few fine roots; thin continuous dark yellowish brown (10YR 3/4) clay films on faces of peds; few glacial pebbles; neutral; clear wavy boundary.

C—30 to 60 inches; yellowish brown (10YR 5/4) loam; massive; firm; thin discontinuous light gray (10YR 7/2) calcium carbonate coatings in vertical cracks, decreasing in number with increasing depth; few glacial pebbles; strong effervescence; moderately alkaline.

The solum is 24 to 40 inches thick. It is neutral to medium acid.

The Ap horizon has chroma of 2 to 4. Pedons in areas that have not been cultivated have an A horizon. This horizon has hue of 10YR, value of 3, and chroma of 1 or 2. The Ap or A horizon is dominantly sandy loam. In some pedons, however, it is silt loam or loam, and in severely eroded areas it is clay loam. Some pedons have an E horizon. This horizon has hue of 10YR, value of 4 to 6, and chroma of 2 to 4. It is loam, silt loam, or sandy loam. The Bt horizon has value of 4 or 5 and chroma of 3 to 6. The C horizon has chroma of 3 or 4.

Milford Series

The Milford series consists of deep, very poorly drained, moderately slowly permeable soils in deep depressions and small glacial lakebeds on till plains and moraines. These soils formed in lacustrine deposits. Slopes range from 0 to 2 percent.

Milford soils are similar to Coesse, Pewamo, and Saranac soils and are commonly adjacent to Boots, Fulton, Houghton, Martisco, and Muskego soils. Coesse soils have 20 inches or more of lighter colored, silty alluvium that has been deposited over the original dark surface soil. Pewamo soils are underlain by glacial till and are not stratified in the underlying material. Saranac soils have more sand in the underlying material than the Milford soils. Boots, Houghton, Martisco, and Muskego soils have an organic surface layer. They are in the deep depressions. The somewhat poorly drained Fulton soils are on the slightly higher parts of the landscape. They have a surface layer that is lighter colored than that of the Milford soils and are less gray in the subsoil.

Typical pedon of Milford silty clay loam, in a cultivated field; 100 feet south and 675 feet east of the northwest corner of sec. 22, T. 32 N., R. 8 E.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium granular structure; firm; few fine roots; neutral; abrupt smooth boundary.

A—8 to 13 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate medium granular structure; firm; few fine roots; neutral; clear wavy boundary.

Bg1—13 to 17 inches; dark gray (N 4/0) silty clay; many medium faint olive brown (2.5Y 4/4) mottles; moderate fine angular blocky structure; firm; few fine roots; thin continuous black (10YR 2/1) organic coatings on faces of peds; neutral; gradual smooth boundary.

Bg2—17 to 28 inches; gray (N 5/0) silty clay; common medium faint light olive brown (2.5Y 5/4) mottles; moderate fine angular blocky structure; firm; few fine roots; thin continuous black (10YR 2/1) organic coatings on vertical faces of peds; neutral; gradual smooth boundary.

Bg3—28 to 42 inches; gray (N 5/0) silty clay; few medium faint light olive brown (2.5Y 5/4) mottles; weak medium angular blocky structure; firm; few fine roots; slight effervescence; mildly alkaline; gradual smooth boundary.

Cg—42 to 60 inches; gray (N 5/0) stratified silty clay and silty clay loam; few medium faint light olive brown (2.5Y 5/4) mottles; massive; firm; few snail shells; strong effervescence; moderately alkaline.

The solum is 36 to 60 inches thick. It is mildly alkaline to slightly acid. The mollic epipedon is 12 to 20 inches thick.

The A horizon has hue of 2.5Y or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. The Bg horizon has hue of 2.5Y or 10YR or is neutral in hue. It has value of 4 or 5 and chroma of 0 to 2. It is silty clay loam or silty clay. The C horizon has hue of 10YR or 2.5Y or is neutral in hue. It has value of 5 or 6 and chroma of 0 to 4. It is dominantly silty clay or silty clay loam, but some pedons have thin strata of silt loam to fine sandy loam.

Morley Series

The Morley series consists of deep, well drained, slowly permeable soils on moraines and till plains. These soils formed in dense glacial till. Slopes range from 3 to 30 percent.

Morley soils are similar to Glynwood, Miami, and Rawson soils and are adjacent to Blount, Hennepin, and Seward soils. Glynwood soils have mottles in the upper part of the subsoil. Miami and Rawson soils have less clay in the upper part of the solum than the Morley soils. The somewhat poorly drained Blount soils are on foot slopes and in drainageways. They have mottles in the upper part of the subsoil. Hennepin soils have a solum that is thinner than that of the Morley soils and have less clay in the subsoil. They are on steep breaks along drainageways. The moderately well drained Seward soils are on ridgetops. They have less clay and more sand in the upper part of the solum than the Morley soils.

Typical pedon of Morley loam, 3 to 6 percent slopes, eroded, in a cultivated field; 2,425 feet west and 2,375 feet north of the southeast corner of sec. 8, T. 31 N., R. 9 E.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) loam, pale brown (10YR 6/3) dry; mixed with yellowish brown (10YR 5/4) clay loam; weak fine granular structure; friable; common fine roots; neutral; abrupt smooth boundary.

Bt1—10 to 13 inches; yellowish brown (10YR 5/4) clay; moderate fine subangular blocky structure; firm; few fine roots; thin discontinuous dark yellowish brown (10YR 3/4) clay films on faces of peds; few glacial pebbles; medium acid; clear wavy boundary.

Bt2—13 to 18 inches; yellowish brown (10YR 5/4) clay; moderate medium subangular blocky structure; firm; few fine roots; thin continuous brown (10YR 5/3) clay films on faces of peds; few glacial pebbles; medium acid; clear wavy boundary.

Bt3—18 to 21 inches; dark yellowish brown (10YR 4/4) clay; moderate coarse subangular blocky structure; firm; few fine roots; thin continuous dark brown (10YR 4/3) clay films on faces of peds; few glacial pebbles; slightly acid; clear wavy boundary.

BC—21 to 24 inches; dark yellowish brown (10YR 4/4) clay loam; weak coarse subangular blocky structure; firm; few roots; thin discontinuous dark brown (10YR 4/3) clay films on faces of peds; few glacial pebbles; neutral; clear irregular boundary.

C—24 to 60 inches; yellowish brown (10YR 5/4) clay loam; massive; very firm; few glacial pebbles; common medium light brownish gray (10YR 6/2) calcium carbonate deposits in cracks; strong effervescence; moderately alkaline.

The solum is 20 to 40 inches thick. Reaction is neutral to medium acid in the A, E, and Bt horizons and neutral to moderately alkaline in the BC horizon.

The Ap horizon has chroma of 1 to 3. Pedons in undisturbed areas have an A horizon, which has value of 3. The Ap or A horizon is dominantly silt loam or loam, but in severely eroded areas it is clay loam or silty clay loam. Some pedons have an E horizon. This horizon has hue of 10YR, value of 5, and chroma of 3. It is silt loam or loam. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. In some pedons it has mottles with low chroma in the lower part. It is clay, clay loam, silty clay loam, or silty clay. The BC horizon has value of 4 or 5 and chroma of 2 to 4. In some pedons it is mottled. It is clay loam or silty clay loam. The C horizon has chroma of 3 or 4. It is clay loam or silty clay loam.

Muskego Series

The Muskego series consists of deep, very poorly drained, slowly permeable soils in deep depressions on till plains and moraines. These soils formed in organic material over coprogenous earth. Slopes range from 0 to 2 percent.

Muskego soils are similar to Adrian, Houghton, Martisco, and Palms soils and are adjacent to Milford and Rensselaer soils. Adrian soils are underlain by sandy material. Houghton soils are organic to a depth of more than 51 inches. Martisco soils are underlain by marl. Palm soils are underlain by loamy material. Milford and Rensselaer are mineral soils. They are on the slightly higher rises and along the edges of the depressions.

Typical pedon of Muskego muck, clay loam substratum, drained, in a cultivated field; 300 feet north and 340 feet east of the center of sec. 33, T. 30 N., R. 8 E.

Op—0 to 6 inches; sapric material, black (10YR 2/1) broken face, rubbed, and pressed; about 2 percent fiber, a trace rubbed; moderate fine granular structure; very friable; few roots; herbaceous fibers; about 20 percent mineral material; neutral; abrupt smooth boundary.

Oa1—6 to 10 inches; sapric material, black (10YR 2/1) broken face, rubbed, and pressed; about 3 percent fiber, a trace rubbed; moderate medium granular structure; very friable; few roots; herbaceous fibers; about 15 percent mineral material; neutral; clear smooth boundary.

Oa2—10 to 18 inches; sapric material, dark brown (7.5YR 3/2) broken face, rubbed, and pressed; about 10 percent fiber, less than 3 percent rubbed;

strong medium platy structure; firm; few roots; many thin dark reddish brown (5YR 3/4) streaks along horizontal plates; herbaceous fibers; about 50 percent mineral material; medium acid; gradual smooth boundary.

C1—18 to 26 inches; very dark grayish brown (2.5Y 3/2) coprogenous earth; moderate thin platy structure; firm; few roots; common thin dark reddish brown (5YR 3/4) streaks along horizontal plates; medium acid; gradual smooth boundary.

C2—26 to 36 inches; dark olive gray (5Y 3/2) coprogenous earth; massive; friable; slightly acid; gradual smooth boundary.

C3—36 to 47 inches; olive gray (5Y 4/2) coprogenous earth; massive; friable; neutral; abrupt smooth boundary.

C4—47 to 52 inches; olive gray (5Y 4/2) coprogenous earth; massive; friable; common shells; slight effervescence; mildly alkaline; abrupt smooth boundary.

C5—52 to 60 inches; gray (5Y 5/1) clay loam; massive; friable; few glacial pebbles; strong effervescence; moderately alkaline.

The organic material is 16 to 40 inches thick. The fiber is derived primarily from herbaceous plants.

The O horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 to 3. It is dominantly sapric material. It is neutral to medium acid. The coprogenous earth has hue of 10YR, 2.5Y, or 5Y, value of 3 to 5, and chroma of 1 to 3. It is medium acid to mildly alkaline. The C5 horizon has value of 4 or 5 and chroma of 1 or 2. It is silty clay loam or clay loam. It is neutral to moderately alkaline.

Ormas Series

The Ormas series consists of deep, well drained soils on river terraces and outwash plains. These soils formed in sandy, loamy, and gravelly glacial outwash. They are moderately rapidly permeable in the solum and very rapidly permeable in the underlying material. Slopes range from 0 to 4 percent.

Ormas soils are similar to Boyer, Kalamazoo, Oshtemo, Seward, and Spinks soils and are adjacent to Sebewa soils. Boyer, Kalamazoo, and Oshtemo soils have less sand in the upper part of the solum than the Ormas soils. Seward soils have more clay in the lower part of the subsoil and in the underlying material than the Ormas soils. Spinks soils have more sand in the subsoil than the Ormas soils. Also, their subsoil is not continuous. The very poorly drained Sebewa soils are in depressions. They have a surface layer that is darker than that of the Ormas soils and have a grayish, mottled subsoil.

Typical pedon of Ormas loamy fine sand, 0 to 4 percent slopes, in a cultivated field; 400 feet east and 2,500 feet south of the northwest corner of sec. 4, T. 30 N., R. 8 E.

Ap—0 to 9 inches; dark brown (10YR 4/3) loamy fine sand, pale brown (10YR 6/3) dry; weak fine granular structure; loose; few fine roots; medium acid; abrupt smooth boundary.

E—9 to 21 inches; light yellowish brown (10YR 6/4) loamy fine sand; single grain; loose; few fine roots; slightly acid; clear smooth boundary.

Bt1—21 to 25 inches; dark brown (10YR 4/3) sandy loam; weak coarse subangular blocky structure; friable; few fine roots; dark yellowish brown (10YR 4/4) clay bridges between sand grains; slightly acid; clear wavy boundary.

2Bt2—25 to 30 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 4/4) clay films on faces of peds and on the surface of pebbles; about 16 percent gravel; slightly acid; clear wavy boundary.

2Bt3—30 to 38 inches; dark brown (7.5YR 4/4) gravelly sandy clay loam; weak medium subangular blocky structure; friable; thin discontinuous dark brown (7.5YR 4/4) clay films on faces of peds and on the surface of pebbles; about 18 percent gravel; slightly acid; clear irregular boundary.

2Bt4—38 to 48 inches; dark brown (7.5YR 4/4) gravelly sandy clay loam; weak coarse subangular blocky structure; friable; thin discontinuous dark yellowish brown (10YR 3/4) clay films on faces of peds and on the surface of pebbles; about 20 percent gravel; neutral; abrupt irregular boundary.

2C—48 to 60 inches; brown (10YR 5/3) stratified sand and gravelly coarse sand; single grain; loose; about 30 percent gravel; strong effervescence; moderately alkaline.

The solum is 45 to 72 inches thick. It is neutral to medium acid.

The Ap and E horizons are loamy fine sand to sand. The Ap horizon has value of 3 to 5 and chroma of 2 or 3. The E horizon has value of 5 or 6 and chroma of 3 or 4. The Bt and 2Bt horizons have hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. They are sandy loam, sandy clay loam, or the gravelly analogs of these textures. The 2C horizon has value of 5 or 6 and chroma of 3 or 4. It is coarse sand, gravelly coarse sand, or sand.

Oshtemo Series

The Oshtemo series consists of deep, well drained soils on river terraces and outwash plains. These soils formed in loamy, sandy, and gravelly glacial outwash. They are moderately rapidly permeable in the solum and very rapidly permeable in the underlying material. Slopes range from 0 to 2 percent.

Oshtemo soils are similar to Boyer, Kalamazoo, and Ormas soils and are adjacent to Sebewa soils. Boyer soils have a solum that is thinner than that of the Oshtemo soils. Kalamazoo soils have more clay in the upper part of the subsoil than the Oshtemo soils. Ormas soils have more sand and less clay in the upper part of the solum than the Oshtemo soils. The very poorly drained Sebewa soils are in depressions. They have a grayish, mottled subsoil and have a surface layer that is thicker and darker than that of the Oshtemo soils.

Typical pedon of Oshtemo sandy loam, 0 to 2 percent slopes, in a cultivated field; 1,000 feet east and 600 feet north of the southwest corner of sec. 36, T. 31 N., R. 8 E.

Ap—0 to 10 inches; dark brown (10YR 4/3) sandy loam, pale brown (10YR 6/3) dry; weak fine granular structure; very friable; common fine roots; medium acid; abrupt smooth boundary.

Bt1—10 to 18 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate fine subangular blocky structure; very friable; few fine roots; thin continuous dark yellowish brown (10YR 3/4) clay bridges between sand grains; about 12 percent gravel; slightly acid; clear wavy boundary.

Bt2—18 to 34 inches; dark brown (7.5YR 4/4) gravelly sandy loam; moderate fine subangular blocky structure; friable; few fine roots; thin patchy dark yellowish brown (10YR 3/4) clay films on faces of peds; about 18 percent gravel; slightly acid; clear wavy boundary.

Bt3—34 to 40 inches; dark brown (7.5YR 4/4) sandy loam; weak medium subangular blocky structure; friable; few fine roots; thin patchy dark yellowish brown (10YR 3/4) clay bridges between sand grains; about 8 percent gravel; slightly acid; clear wavy boundary.

Bt4—40 to 45 inches; dark yellowish brown (10YR 4/4) gravelly sandy clay loam; moderate fine subangular blocky structure; friable; few fine roots; thin discontinuous dark yellowish brown (10YR 3/4) clay films on faces of peds; about 20 percent gravel; neutral; abrupt irregular boundary.

2C—45 to 60 inches; pale brown (10YR 6/3) stratified gravelly coarse sand and sand; single grain; loose; about 18 percent gravel; strong effervescence; moderately alkaline.

The solum is 40 to 66 inches thick. It is neutral to strongly acid.

The A horizon has value of 3 or 4 and chroma of 2 or 3. It is sandy loam or loamy sand. Some pedons have an E horizon. This horizon has hue of 10YR, value of 5 or 6, and chroma of 3 to 6. It is sandy loam or loamy sand. The B horizon has hue of 10YR, 7.5YR, or 5YR, value of 3 to 5, and chroma of 3 to 6. It is sandy loam, sandy clay loam, or the gravelly analogs of these textures. The 2C horizon has value of 5 or 6 and chroma of 3 or 4.

Palms Series

The Palms series consists of deep, very poorly drained soils in deep depressions on outwash plains, terraces, and bottom land. These soils formed in organic material over silty and sandy outwash. Permeability is moderately slow to moderately rapid in the organic material, moderate or moderately slow in the silty material, and rapid in the sandy material. Slopes range from 0 to 2 percent.

Palms soils are similar to Adrian, Houghton, Martisco, and Muskego soils and are adjacent to Mermill and Sloan soils. Adrian soils are underlain by sandy material. Houghton soils are organic to a depth of more than 51 inches. Martisco soils are underlain by marl. Muskego soils are underlain by coprogenous earth. Mermill and Sloan are mineral soils. They are on the slightly higher edges of the depressions and adjacent to stream channels on the bottom land.

Typical pedon of Palms muck, sandy substratum, drained, in a cultivated field; 1,620 feet south and 230 feet east of the northwest corner of sec. 8, T. 31 N., R. 10 E.

Op—0 to 9 inches; sapric material, black (10YR 2/1) broken face, pressed, and rubbed; about 2 percent fiber, a trace rubbed; moderate fine granular structure; very friable; few fine roots; herbaceous fibers; about 30 percent mineral material; slightly acid; abrupt smooth boundary.

Oa1—9 to 16 inches; sapric material, black (10YR 2/1) broken face, dark reddish brown (5YR 3/2) pressed and rubbed; about 4 percent fiber, a trace rubbed; moderate medium granular structure; friable; few fine roots; herbaceous fibers; about 20 percent mineral material; slightly acid; clear smooth boundary.

Oa2—16 to 23 inches; sapric material, black (10YR 2/1) broken face, dark reddish brown (5YR 3/2) pressed and rubbed; about 5 percent fiber, a trace rubbed; weak medium subangular blocky structure; friable; few fine roots; herbaceous fibers; about 40 percent mineral material; slightly acid; clear smooth boundary.

Cg1—23 to 29 inches; very dark gray (10YR 3/1) silty clay loam; common medium distinct dark brown (10YR 4/3) mottles; weak fine subangular blocky structure; firm; few fine roots; slightly acid; clear smooth boundary.

Cg2—29 to 36 inches; yellowish brown (10YR 5/4) silt loam; few fine faint grayish brown (10YR 5/2) mottles; weak very fine subangular blocky structure; friable; few fine roots; neutral; clear smooth boundary.

Cg3—36 to 41 inches; dark gray (10YR 4/1) silty clay loam; few fine distinct yellowish brown (10YR 5/4) mottles; weak fine subangular blocky structure; firm; few fine roots; neutral; gradual smooth boundary.
Cg4—41 to 51 inches; very dark gray (10YR 3/1) silt loam; few fine distinct dark yellowish brown (10YR 4/4) mottles; massive; firm; few fine roots; neutral; clear smooth boundary.
Cg5—51 to 56 inches; gray (10YR 5/1) loamy fine sand; many coarse distinct light olive brown (2.5Y 5/4) mottles; single grain; very friable; strong effervescence; moderately alkaline; gradual smooth boundary.
Cg6—56 to 60 inches; dark gray (10YR 4/1) fine sand; few fine distinct yellowish brown (10YR 5/4) mottles; single grain; loose; strong effervescence; moderately alkaline.

The sapric material is 16 to 40 inches thick. The depth to sandy material is 40 to 60 inches. The organic material is derived primarily from herbaceous plants. Reaction ranges from strongly acid to mildly alkaline in the organic material and from slightly acid to moderately alkaline in the mineral material.

The surface tier has hue of 10YR, 7.5YR, or 5YR and chroma of 1 or 2. The subsurface and bottom tiers have hue of 10YR, 7.5YR, or 5YR or are neutral in hue. They have value of 2 or 3 and chroma of 0 to 3. The upper part of the C horizon has hue of 10YR or 2.5Y, value of 3 to 6, and chroma of 1 to 4. It is loam, sandy loam, clay loam, silt loam, or silty clay loam. The lower part has hue of 10YR or 2.5Y or is neutral in hue. It has value of 4 to 6 and chroma of 0 to 2. It is loamy fine sand to gravelly coarse sand.

Pewamo Series

The Pewamo series consists of deep, very poorly drained, moderately slowly permeable soils in depressions and drainageways on till plains and moraines. These soils formed in glacial till. Slopes range from 0 to 2 percent.

Pewamo soils are similar to Brookston, Coesse, Mermill, and Milford soils and are commonly adjacent to Blount, Boots, Glynwood, Haskins, and Houghton soils. The somewhat poorly drained Blount and Haskins and moderately well drained Glynwood soils are on the higher, convex parts of the landscape. They do not have a thick, dark surface layer and are less gray in the subsoil than the Pewamo soils. Boots and Houghton soils formed in organic material and are in the deep depressions. Brookston and Mermill soils have less clay and more sand in the upper part of the subsoil than the Pewamo soils. Coesse soils have 20 inches or more of lighter colored, silty alluvium that has been deposited over the original dark surface soil. Milford soils are stratified in the underlying material.

Typical pedon of Pewamo silty clay loam, in a cultivated field; 480 feet north and 2,580 feet east of the southwest corner of sec. 18, T. 31 N., R. 9 E.

Ap—0 to 11 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium granular structure; friable; few fine roots; slightly acid; abrupt smooth boundary.
Btg1—11 to 24 inches; dark gray (10YR 4/1) clay; many medium distinct light olive brown (2.5Y 5/4) mottles; moderate fine angular blocky structure; firm; few fine roots; thin discontinuous very dark gray (10YR 3/1) clay films on faces of peds; thin continuous black (10YR 2/1) organic coatings on vertical faces of peds; neutral; clear wavy boundary.
Btg2—24 to 31 inches; dark gray (10YR 4/1) clay; many medium distinct light olive brown (2.5Y 5/4) mottles; moderate fine subangular blocky structure; firm; few fine roots; thin continuous very dark gray (10YR 3/1) clay films on faces of peds; neutral; clear wavy boundary.
Btg3—31 to 43 inches; gray (10YR 5/1) silty clay loam; many medium distinct yellowish brown (10YR 5/4) mottles; moderate fine subangular blocky structure; firm; few fine roots; thin continuous dark gray (10YR 4/1) clay films on faces of peds; few glacial pebbles; neutral; clear wavy boundary.
BCg—43 to 47 inches; gray (10YR 5/1) clay loam; many medium distinct yellowish brown (10YR 5/4) mottles; weak coarse subangular blocky structure; firm; thin discontinuous grayish brown (10YR 5/2) clay films on vertical faces of peds; few glacial pebbles; slight effervescence; mildly alkaline; gradual wavy boundary.
C—47 to 60 inches; yellowish brown (10YR 5/4) clay loam; many fine distinct grayish brown (10YR 5/2) mottles; massive; very firm; thin continuous gray (10YR 5/1) coatings in vertical cracks; few glacial pebbles; strong effervescence; moderately alkaline.

The solum is 28 to 70 inches thick. Reaction is slightly acid or neutral in the A and Btg horizons and neutral or mildly alkaline in the BC horizon.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is silty clay loam, clay loam, or silt loam. The Btg horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is clay loam, silty clay loam, clay, or silty clay. The BC and C horizons are clay loam or silty clay loam. The BC horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 4. The C horizon has value of 4 to 6 and chroma of 1 to 4.

Rawson Series

The Rawson series consists of deep, moderately well drained soils on till plains and moraines. These soils formed in loamy glacial outwash and in the underlying dense glacial till. They are moderately permeable in the upper part of the solum and slowly permeable in the lower part and in the underlying material. Slopes range from 0 to 12 percent.

Rawson soils are similar to Glynwood, Miami, Morley, Riddles, and Seward soils and are adjacent to Haskins, Mermill, and Spinks soils. Glynwood and Morley soils have more clay and less sand in the upper part of the solum than the Rawson soils. Miami and Riddles soils have less clay in the lower part of the subsoil and in the underlying material than the Rawson soils. Seward soils have more sand in the upper part of the solum than the Rawson soils. Haskins soils are somewhat poorly drained and are on foot slopes and in nearly level areas. They have mottles in the upper part of the subsoil. Mermill soils are very poorly drained and are in depressions and drainageways. They have a surface layer that is thicker and darker than that of the Rawson soils and are grayer in the subsoil. Spinks soils are well drained and are on the tops of hills and ridges. They have more sand and less clay throughout than the Rawson soils.

Typical pedon of Rawson sandy loam, 2 to 6 percent slopes, in a cultivated field; 2,575 feet north and 425 feet east of the southwest corner of sec. 6, T. 31 N., R. 9 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) sandy loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; very friable; few fine roots; slightly acid; abrupt smooth boundary.

Bt1—9 to 15 inches; yellowish brown (10YR 5/4) sandy loam; weak fine subangular blocky structure; very friable; few fine roots; thin patchy dark yellowish brown (10YR 4/4) clay films on faces of peds; about 5 percent gravel; slightly acid; clear wavy boundary.

Bt2—15 to 21 inches; dark yellowish brown (10YR 4/4) sandy clay loam; moderate medium subangular blocky structure; friable; few fine roots; thin discontinuous dark brown (7.5YR 4/4) clay films on faces of peds; about 2 percent gravel; slightly acid; clear wavy boundary.

Bt3—21 to 26 inches; dark brown (7.5YR 4/4) sandy clay loam; moderate medium subangular blocky structure; friable; few fine roots; thin discontinuous dark brown (7.5YR 4/4) clay films on faces of peds; about 2 percent gravel; slightly acid; clear wavy boundary.

Bt4—26 to 31 inches; dark brown (7.5YR 4/4) sandy clay loam; few medium distinct dark grayish brown (10YR 4/2) mottles; weak medium subangular blocky structure; friable; few fine roots; thin continuous dark brown (7.5YR 4/4) clay films on faces of peds; about 2 percent gravel; slightly acid; clear smooth boundary.

2Bt5—31 to 34 inches; yellowish brown (10YR 5/4) clay; few fine faint grayish brown (10YR 5/2) mottles; moderate coarse subangular blocky structure; firm; few fine roots; thin continuous dark yellowish brown (10YR 4/4) clay films on faces of peds; about 2 percent gravel; neutral; gradual wavy boundary.

2BC—34 to 38 inches; yellowish brown (10YR 5/4) clay loam; few fine faint grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; firm; about 2 percent gravel; neutral; gradual wavy boundary.

2C—38 to 60 inches; brown (10YR 5/3) clay loam; few fine faint grayish brown (10YR 5/2) mottles; massive; very firm; about 2 percent gravel; strong effervescence; moderately alkaline.

The solum is 26 to 48 inches thick. The Ap horizon has value of 4 or 5 and chroma of 2 or 3. It is sandy loam or loam. It is medium acid to neutral. Some pedons have an E horizon. This horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. It is sandy loam or loam. It is neutral to strongly acid.

The Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. In most pedons it has mottles with low chroma in the lower part. It is dominantly sandy clay loam or sandy loam, but in some pedons it has layers of clay loam, loam, or the gravelly analogs of these textures. It is slightly acid to strongly acid. The 2Bt horizon has value of 4 or 5 and chroma of 2 to 4. In many pedons it is mottled. It is clay, clay loam, or silty clay loam. It is neutral or mildly alkaline.

The 2BC and 2C horizons are clay loam or silty clay loam. In some pedons they have mottles with low chroma. The 2BC horizon has value of 4 or 5 and chroma of 3 or 4. It is neutral to moderately alkaline. The 2C horizon has chroma of 3 or 4.

Rensselaer Series

The Rensselaer series consists of deep, very poorly drained, moderately permeable soils in depressions on outwash plains and terraces. These soils formed in stratified, loamy and sandy glacial outwash. Slopes range from 0 to 2 percent.

Rensselaer soils are similar to Brookston, Mermill, and Sebewa soils and are adjacent to Adrian, Houghton, Martinsville, Martisco, Muskego, and Whitaker soils. Brookston and Mermill soils are underlain by glacial till. Sebewa soils contain more gravel throughout than the Rensselaer soils. Adrian, Houghton, Martisco, and Muskego soils have a surface layer of muck. They are in deep depressions. The well drained Martinsville and somewhat poorly drained Whitaker soils are in the higher positions on the landscape. They do not have a thick, dark surface soil.

Typical pedon of Rensselaer loam, in a cultivated field; 375 feet west and 1,725 feet north of the southeast corner of sec. 6, T. 30 N., R. 8 E.

Ap—0 to 10 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

A—10 to 14 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; moderate medium granular structure; friable; few fine roots; neutral; clear smooth boundary.

Btg1—14 to 21 inches; dark gray (10YR 4/1) clay loam; common fine distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin continuous very dark grayish brown (10YR 3/2) clay films on faces of peds; thin continuous very dark gray (10YR 3/1) organic coatings on vertical faces of peds; neutral; clear smooth boundary.

Btg2—21 to 34 inches; grayish brown (10YR 5/2) sandy clay loam; many fine distinct light olive brown (2.5Y 5/4) mottles; weak coarse subangular blocky structure; friable; few fine roots; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; thin continuous very dark gray (10YR 3/1) organic coatings on vertical faces of peds; neutral; gradual smooth boundary.

Btg3—34 to 43 inches; grayish brown (2.5Y 5/2) sandy loam; many fine distinct light olive brown (2.5Y 5/4) mottles; weak coarse subangular blocky structure; friable; few fine roots; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; neutral; clear smooth boundary.

BC—43 to 48 inches; grayish brown (10YR 5/2) loamy sand; common medium distinct yellowish brown (10YR 5/4) mottles; weak coarse subangular blocky structure; very friable; neutral; clear wavy boundary.

Cg1—48 to 55 inches; grayish brown (10YR 5/2) stratified sandy loam, loamy sand, and sand; few fine distinct yellowish brown (10YR 5/4) mottles; massive and single grain; loose; neutral; abrupt smooth boundary.

Cg2—55 to 60 inches; gray (10YR 5/1) stratified sandy loam, loamy sand, and sand; massive and single grain; loose; strong effervescence; moderately alkaline.

The solum is 40 to 60 inches thick. The A horizon has value of 2 or 3 and chroma of 1 or 2. It is dominantly loam or silt loam but in some pedons is silty clay loam or clay loam. It is neutral or slightly acid. The Btg horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is dominantly sandy clay loam, clay loam, or sandy loam, but in some pedons it has layers of silty clay loam or loam. It is slightly acid to mildly alkaline. The C horizon has value of 4 to 6 and chroma of 1 or 2. It is stratified loamy sand, sand, sandy loam, loam, or silt loam.

Riddles Series

The Riddles series consists of deep, well drained, moderately permeable soils on moraines. These soils formed in glacial till. Slopes range from 1 to 12 percent.

Riddles soils are similar to Martinsville, Miami, Rawson, and Wawasee soils and are adjacent to Brookston and Crosier soils. Martinsville soils have more sand and are more stratified in the lower part of the solum and in the underlying material than the Riddles soils. Miami and Wawasee soils have a solum that is thinner than that of the Riddles soils. Rawson soils have more clay in the lower part of the subsoil and in the underlying material than the Riddles soils. The very poorly drained Brookston and somewhat poorly drained Crosier soils are in low areas and in depressions. They have mottles in the upper part of the subsoil.

Typical pedon of Riddles sandy loam, 1 to 6 percent slopes, in a cultivated field; 1,160 feet north and 150 feet west of the southeast corner of sec. 32, T. 32 N., R. 8 E.

Ap—0 to 10 inches; dark brown (10YR 4/3) sandy loam, pale brown (10YR 6/3) dry; weak fine granular structure; friable; few fine roots; about 2 percent gravel; neutral; abrupt smooth boundary.

E—10 to 13 inches; yellowish brown (10YR 5/4) sandy loam; moderate medium platy structure; friable; few fine roots; thin continuous pale brown (10YR 6/3) coatings on faces of peds; about 2 percent gravel; slightly acid; clear wavy boundary.

Bt1—13 to 18 inches; dark yellowish brown (10YR 4/4) clay loam; moderate fine subangular blocky structure; firm; few fine roots; thin discontinuous dark yellowish brown (10YR 3/4) clay films on faces of peds; thin continuous pale brown (10YR 6/3) coatings on vertical faces of peds; about 2 percent gravel; slightly acid; clear wavy boundary.

Bt2—18 to 27 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few fine roots; thin continuous dark yellowish brown (10YR 3/4) clay films on faces of peds; about 2 percent gravel; medium acid; gradual wavy boundary.

Bt3—27 to 35 inches; yellowish brown (10YR 5/4) loam; weak medium subangular blocky structure; firm; few fine roots; thin patchy dark yellowish brown (10YR 3/4) clay films on faces of peds; about 2 percent gravel; medium acid; gradual wavy boundary.

Bt4—35 to 48 inches; yellowish brown (10YR 5/4) loam; weak coarse subangular blocky structure; firm; thin patchy dark yellowish brown (10YR 4/4) clay films on faces of peds; about 2 percent gravel; neutral; clear wavy boundary.

C—48 to 60 inches; brown (10YR 5/3) loam; massive; firm; about 2 percent gravel; strong effervescence; moderately alkaline.

The solum is 40 to 72 inches thick. The A horizon has value of 4 or 5 and chroma of 2 to 4. It is loam, silt loam, or sandy loam. It is neutral to medium acid. Some pedons have an E horizon. This horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is clay loam, loam, sandy clay loam, sandy loam, or silty clay loam. It is neutral to medium acid. Some pedons have a BC horizon. This horizon is neutral or mildly alkaline. The C horizon has chroma of 3 or 4. It is loam or sandy loam.

Saranac Series

The Saranac series consists of deep, very poorly drained soils on bottom land and in small glacial lakebeds. These soils formed in alluvium over sandy outwash. They are moderately slowly permeable in the solum and moderately rapidly permeable in the underlying material. Slopes range from 0 to 2 percent.

Saranac soils are similar to Coesse, Milford, and Sloan soils and are commonly adjacent to Houghton, Shoals, and Wallkill soils. Coesse soils have more than 20 inches of lighter colored, silty alluvium that has been deposited over the original dark surface soil. Milford soils have a stronger structure in the subsoil than the Saranac soils. Sloan soils have more sand and less clay in the subsoil than the Saranac soils. Houghton soils are organic. They are in deep depressions. The somewhat poorly drained Shoals soils are in the slightly higher areas near stream channels. They have a surface soil that is lighter colored than that of the Saranac soils. Wallkill soils are underlain by organic material. They are in the lower depressions.

Typical pedon of Saranac silty clay loam, sandy substratum, frequently flooded, in a cultivated field; 200 feet south and 2,100 feet east of the northwest corner of sec. 36, T. 32 N., R. 9 E.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; firm; common fine roots; neutral; abrupt smooth boundary.

A—8 to 11 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium granular structure; firm; few fine roots; thin continuous black (10YR 2/1) organic coatings on faces of peds; neutral; clear smooth boundary.

Bg1—11 to 14 inches; very dark gray (10YR 3/1) silty clay; common medium distinct dark yellowish brown (10YR 3/4) mottles; weak fine subangular blocky structure; firm; few fine roots; thin discontinuous black (10YR 2/1) organic coatings on faces of peds; neutral; clear smooth boundary.

Bg2—14 to 20 inches; dark gray (10YR 4/1) silty clay; common medium distinct dark brown (10YR 4/3) mottles; weak fine angular blocky structure; firm; few fine roots; neutral; clear smooth boundary.

Bg3—20 to 36 inches; gray (10YR 5/1) clay; many medium distinct dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; firm; few fine roots; neutral; clear smooth boundary.

Bg4—36 to 46 inches; yellowish brown (10YR 5/6) silty clay; many fine distinct gray (10YR 5/1) mottles; weak very fine subangular blocky structure; firm; few fine roots; neutral; clear smooth boundary.

2Cg1—46 to 50 inches; dark gray (10YR 4/1) stratified sandy clay loam and sandy loam; few medium distinct brown (10YR 4/3) mottles; massive; friable; slight effervescence; mildly alkaline; clear smooth boundary.

2Cg2—50 to 60 inches; gray (10YR 5/1) stratified sand and fine sand; single grain; loose; slight effervescence; mildly alkaline.

The solum is 25 to 60 inches thick. It is neutral or slightly acid. The mollic epipedon is 10 to 17 inches thick.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is silty clay loam or silt loam. The Bg horizon has hue of 2.5Y or 10YR, value of 3 to 5, and chroma of 1 to 6. It is silty clay loam, silty clay, clay loam, or clay. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is dominantly sandy clay loam to gravelly sand, but some pedons have thin strata of silt loam.

Sebewa Series

The Sebewa series consists of deep, very poorly drained soils in depressions and narrow drainageways on outwash plains and river terraces. These soils formed in loamy outwash over sandy and gravelly outwash. They are moderately permeable in the solum and rapidly permeable in the underlying material. Slopes range from 0 to 2 percent.

Sebewa soils are similar to Rensselaer soils and are adjacent to Boyer, Homer, Kalamazoo, Ormas, and Oshtemo soils. Rensselaer soils have a solum that is thicker than that of the Sebewa soils and have less gravel throughout. The well drained Boyer, Kalamazoo, Ormas, and Oshtemo and somewhat poorly drained Homer soils are in the higher, convex areas. They do not have a thick, dark surface layer and are less gray in the subsoil than the Sebewa soils.

Typical pedon of Sebewa loam, in a cultivated field; 1,350 feet south and 2,150 feet east of the northwest corner of sec. 3, T. 30 N., R. 8 E.

Ap—0 to 10 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak fine granular structure; friable; common fine roots; about 5 percent gravel; neutral; abrupt smooth boundary.

A—10 to 13 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate coarse granular structure;

firm; few fine roots; about 5 percent gravel; neutral; clear wavy boundary.

Btg1—13 to 17 inches; very dark gray (10YR 3/1) clay loam; many fine distinct olive brown (2.5Y 4/4) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin continuous dark gray (N 4/0) clay films on faces of peds; thin continuous black (10YR 2/1) organic coatings on faces of peds; about 8 percent gravel; neutral; clear wavy boundary.

Btg2—17 to 29 inches; dark grayish brown (2.5Y 4/2) sandy clay loam; many fine distinct light olive brown (2.5Y 5/4) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin discontinuous dark grayish brown (2.5Y 4/2) clay films on faces of peds; about 10 percent gravel; neutral; clear smooth boundary.

Btg3—29 to 33 inches; dark gray (10YR 4/1) gravelly sandy loam; few fine distinct brown (10YR 5/3) mottles; weak coarse subangular blocky structure; very friable; thin patchy very dark grayish brown (10YR 3/2) clay films on faces of peds; about 25 percent gravel; strong effervescence; moderately alkaline; clear smooth boundary.

2Cg—33 to 60 inches; gray (10YR 6/1) stratified gravelly coarse sand and sand; single grain; loose; about 30 percent gravel; strong effervescence; moderately alkaline.

The solum is 20 to 40 inches thick. The A horizon has value of 2 or 3 and chroma of 1 or 2. It is loam, clay loam, silt loam, or sandy loam. It is neutral or slightly acid. The Btg horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 1 or 2. It is clay loam, sandy clay loam, loam, sandy loam, or the gravelly analogs of these textures. It is neutral or slightly acid in the upper part and neutral to moderately alkaline in the lower part. The 2Cg horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 or 2. It is loamy sand, sand, gravelly loamy sand, or gravelly coarse sand.

Seward Series

The Seward series consists of deep, moderately well drained soils on till plains and moraines. These soils formed in sandy glacial outwash and in the underlying dense glacial till. Permeability is rapid in the upper part of the solum and slow in the lower part and in the underlying material. Slopes range from 2 to 15 percent.

Seward soils are similar to Ormas, Rawson, and Spinks soils and are adjacent to Morley soils. Ormas soils have more sand and gravel in the lower part of the solum and in the underlying material than the Seward soils. Rawson soils have a surface soil that is thinner and has less sand than that of the Seward soils. Spinks soils are well drained. They have less clay in the lower part of the solum and in the underlying material than the Seward soils. Morley soils are well drained and are on side slopes. They have less sand and more clay in the upper part of the solum than the Seward soils.

Typical pedon of Seward loamy fine sand, 2 to 6 percent slopes, in a cultivated field; 575 feet north and 125 feet west of the southeast corner of sec. 29, T. 32 N., R. 8 E.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) loamy fine sand, light brownish gray (10YR 6/2) dry; single grain; very friable; few fine roots; slightly acid; abrupt smooth boundary.

E1—10 to 18 inches; brown (10YR 5/3) fine sand; single grain; loose; few fine roots; medium acid; clear wavy boundary.

E2—18 to 26 inches; pale brown (10YR 6/3) sand; single grain; loose; few fine roots; medium acid; clear wavy boundary.

E3—26 to 30 inches; brown (10YR 5/3) loamy sand; single grain; very friable; few fine roots; medium acid; clear wavy boundary.

Bt1—30 to 35 inches; dark yellowish brown (10YR 4/4) sandy clay loam; many fine distinct dark grayish brown (10YR 4/2) mottles; weak medium subangular blocky structure; firm; few fine roots; thin patchy dark yellowish brown (10YR 3/4) clay films on faces of peds; slightly acid; abrupt wavy boundary.

2Bt2—35 to 39 inches; yellowish brown (10YR 5/4) clay loam; many fine distinct gray (10YR 5/1) mottles; weak coarse subangular blocky structure; firm; thin discontinuous dark yellowish brown (10YR 3/4) clay films on vertical faces of peds; few glacial pebbles; neutral; clear wavy boundary.

2C—39 to 60 inches; brown (10YR 5/3) clay loam; many fine distinct gray (10YR 5/1) mottles; massive; very firm; thin continuous gray (10YR 6/1) calcium carbonate coatings in vertical cracks, decreasing in number with increasing depth; few glacial pebbles; strong effervescence; moderately alkaline.

The solum is 30 to 48 inches thick. The Ap horizon has value of 4 or 5 and chroma of 2 to 4. Pedons in undisturbed areas have an A horizon, which has hue of 10YR, value of 3, and chroma of 2 to 4. The Ap or A horizon is loamy fine sand, loamy sand, or fine sand. It is strongly acid to neutral. The E horizon has value of 5 or 6 and chroma of 3 to 6. It is loamy fine sand to sand. The Bt horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 or 4. In some pedons it has mottles with low chroma in the lower part. This horizon is sandy clay loam, clay loam, or silty clay loam. It is slightly acid or neutral.

Some pedons have a 2BC horizon. This horizon has hue of 10YR, value of 5, and chroma of 3 or 4. It is clay loam or silty clay loam. It is neutral to moderately alkaline. The 2C horizon has value of 4 or 5 and chroma of 3 or 4. It is clay loam or silty clay loam.

Shoals Series

The Shoals series consists of deep, somewhat poorly drained soils on bottom land. These soils formed in alluvium over sandy and gravelly outwash. They are moderately permeable in the upper part and rapidly permeable in the underlying material. Slopes range from 0 to 2 percent.

Shoals soils are similar to Whitaker soils and are adjacent to Hennepin, Saranac, Sloan, and Stonelick Variant soils. Whitaker soils have a subsoil. The well drained Hennepin soils formed in glacial till on steep breaks in the uplands. The very poorly drained Saranac and Sloan soils are in depressions in slack-water areas. They have a surface layer that is thicker and darker than that of the Shoals soils. Stonelick Variant soils are well drained and are in the slightly higher positions on the bottom land. They are browner than the Shoals soils and have more sand in the upper part.

Typical pedon of Shoals silt loam, sandy substratum, frequently flooded, in a cultivated field; 500 feet north and 500 feet east of the junction of Washington Road and the Eel River, in the Beaver Reserve:

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; weak fine granular structure; friable; common fine roots; neutral; abrupt smooth boundary.

A—9 to 14 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; moderate medium granular structure; friable; common fine roots; neutral; clear smooth boundary.

Cg1—14 to 23 inches; dark gray (10YR 4/1) loam; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; friable; few fine roots; neutral; gradual smooth boundary.

Cg2—23 to 32 inches; yellowish brown (10YR 5/4) stratified loam and sandy loam; many fine distinct dark grayish brown (10YR 4/2) mottles; weak very fine subangular blocky structure; friable; few fine roots; neutral; gradual smooth boundary.

Cg3—32 to 48 inches; dark gray (10YR 4/1) stratified loam and sandy loam; common medium distinct dark brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; friable; few fine roots; neutral; abrupt smooth boundary.

2Cg4—48 to 60 inches; grayish brown (10YR 5/2) stratified gravelly coarse sand and sand; common coarse faint brown (10YR 5/3) mottles; single grain; loose; about 12 percent gravel; strong effervescence; moderately alkaline.

The A and C horizons are neutral or slightly acid. The A horizon is silt loam or loam. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 4. It is stratified silty clay loam, silt loam, loam, or sandy loam. The 2C horizon has value of 5 or 6 and chroma of 1 to 3. It is stratified loamy sand to gravelly coarse sand. It is neutral to moderately alkaline.

Sloan Series

The Sloan series consists of deep, very poorly drained soils on bottom land. These soils formed in loamy alluvium over sandy outwash. They are moderately permeable or moderately slowly permeable in the loamy material and rapidly permeable in the sandy underlying material. Slopes range from 0 to 2 percent.

Sloan soils are similar to Saranac soils and are adjacent to Adrian, Palms, Shoals, and Stonelick Variant soils. Saranac soils have more clay in the subsoil than the Sloan soils. Adrian and Palms soils have a surface layer of muck. They are in deep depressions. The somewhat poorly drained Shoals and well drained Stonelick Variant soils are in the slightly higher positions on the landscape. They do not have a thick, dark surface layer.

Typical pedon of Sloan loam, sandy substratum, frequently flooded, in a cultivated field; 750 feet north and 400 feet west of the southeast corner of sec. 32, T. 31 N., R. 9 E.

Ap—0 to 10 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; few fine roots; neutral; abrupt smooth boundary.

A—10 to 18 inches; very dark brown (10YR 2/2) loam, dark gray (10YR 4/1) dry; weak medium granular structure; friable; few fine roots; neutral; clear wavy boundary.

Bg1—18 to 27 inches; dark gray (10YR 4/1) loam; few fine distinct yellowish brown (10YR 5/4) mottles; weak fine subangular blocky structure; firm; few fine roots; neutral; clear wavy boundary.

Bg2—27 to 33 inches; very dark gray (10YR 3/1) stratified loam and silt loam; few fine distinct brown (10YR 5/3) mottles; weak coarse subangular blocky structure; firm; few fine roots; neutral; clear smooth boundary.

Bg3—33 to 47 inches; very dark gray (10YR 3/1) stratified sandy loam and loam; few fine distinct dark yellowish brown (10YR 4/4) mottles; weak coarse subangular blocky structure; friable; neutral; clear smooth boundary.

Bg4—47 to 54 inches; dark gray (10YR 4/1) stratified loam and sandy loam; common fine distinct brown (10YR 5/3) mottles; massive; friable; neutral; abrupt smooth boundary.

Cg—54 to 60 inches; grayish brown (10YR 5/2) loamy coarse sand; single grain; loose; strong effervescence; moderately alkaline.

The mollic epipedon is 10 to 22 inches thick. The depth to free carbonates ranges from 24 to 60 inches.

Reaction is neutral or slightly acid in the A and Bg horizons and neutral to moderately alkaline in the Cg horizon.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is silty clay loam, clay loam, silt loam, or loam. The Bg horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 1 or 2. It is dominantly silty clay loam, clay loam, loam, or silt loam but has strata of sandy loam. The Cg horizon has value of 4 to 6 and chroma of 1 or 2. It is loamy fine sand to gravelly coarse sand.

Spinks Series

The Spinks series consists of deep, well drained, moderately rapidly permeable soils on moraines. These soils formed in sandy deposits. Slopes range from 2 to 15 percent.

Spinks soils are similar to Ormas and Seward soils and are commonly adjacent to Rawson soils. Ormas and Seward soils have a subsoil that is thicker and has more clay than that of the Spinks soils. The moderately well drained Rawson soils are on side slopes. They have more clay throughout than the Spinks soils.

Typical pedon of Spinks sand, 2 to 6 percent slopes, in a cultivated field; 1,550 feet east and 1,700 feet north of the southwest corner of sec. 29, T. 32 N., R. 8 E.

Ap—0 to 11 inches; very dark grayish brown (10YR 3/2) sand, light brownish gray (10YR 6/2) dry; weak fine granular structure; very friable; common fine roots; slightly acid; abrupt smooth boundary.

E—11 to 25 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; few fine roots; neutral; abrupt irregular boundary.

E&Bt—25 to 74 inches; pale brown (10YR 6/3) sand (E); single grain; loose; neutral; several thin lamellae of dark brown (7.5YR 4/4) loamy sand (Bt); weak fine granular structure; very friable; lamellae are 1/8 inch to 4 inches thick, are spaced 6 to 10 inches apart, and have a cumulative thickness of 11 inches; clay bridges between sand grains in the bands; slightly acid; abrupt irregular boundary.

C—74 to 80 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; neutral.

The solum is 40 to more than 60 inches thick. It is medium acid to neutral.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. The E horizon has value of 4 to 6 and chroma of 3 to 6. The A and E horizons are loamy sand or sand. The Bt part of the E&Bt horizon occurs as lamellae, which are 1/8 inch to 4 inches thick, are spaced 6 to 10 inches apart, and have a cumulative thickness of more than 6 inches. It has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. It is loamy sand or sandy loam. The depth to the uppermost lamella ranges from 18 to 36 inches. The C horizon has value of 5 to 7 and chroma of 3 or 4. It is sand or fine sand. It is neutral to moderately alkaline.

Stonelick Variant

The Stonelick Variant consists of deep, well drained, moderately rapidly permeable soils on bottom land. These soils formed in loamy and sandy alluvium. Slopes range from 0 to 2 percent.

Stonelick Variant soils are adjacent to the somewhat poorly drained Shoals and very poorly drained Sloan soils. The adjacent soils have mottles in the upper part of the solum. They are on the lower bottom land.

Typical pedon of Stonelick Variant sandy loam, occasionally flooded, in a cultivated field; 1,200 feet east and 1,350 feet south of the northwest corner of sec. 14, T. 31 N., R. 9 E.

Ap—0 to 10 inches; brown (10YR 4/3) sandy loam, pale brown (10YR 6/3) dry; weak fine granular structure; very friable; few fine roots; neutral; abrupt smooth boundary.

C1—10 to 16 inches; dark brown (7.5YR 4/4) fine sandy loam; weak coarse subangular blocky structure; very friable; few fine roots; neutral; clear smooth boundary.

C2—16 to 32 inches; dark brown (7.5YR 4/4) loamy fine sand; weak coarse subangular blocky structure; very friable; few fine roots; neutral; clear smooth boundary.

C3—32 to 35 inches; brown (10YR 5/3) loamy fine sand; common medium faint grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; very friable; few fine roots; neutral; clear smooth boundary.

Cg1—35 to 42 inches; grayish brown (10YR 5/2) fine sandy loam; many fine faint brown (10YR 5/3) mottles; weak coarse subangular blocky structure; friable; few fine roots; neutral; clear smooth boundary.

Cg2—42 to 55 inches; gray (10YR 5/1) sandy loam; many medium distinct brown (10YR 5/3) and yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; friable; neutral; abrupt smooth boundary.

2Cg3—55 to 60 inches; gray (10YR 6/1) sand; common medium faint pale brown (10YR 6/3) mottles; single grain; loose; slight effervescence; mildly alkaline.

The depth to free carbonates ranges from 20 to 60 inches. Reaction is neutral or slightly acid in the A, C, and Cg horizons and mildly alkaline or moderately alkaline in the 2Cg horizon.

The A horizon has value of 3 or 4 and chroma of 2 or 3. It is commonly fine sandy loam or sandy loam but in some pedons is loamy fine sand or loam. The C horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is fine sandy loam to loamy sand. The Cg horizon has value of 4 or 5 and chroma of 1 or 2. It is loamy fine sand to loam. The 2Cg horizon has value of 4 to 6 and chroma of 1 to 4. It is stratified silt loam to sand.

Wallkill Series

The Wallkill series consists of deep, very poorly drained, moderately slowly permeable to moderately rapidly permeable soils in deep depressions on till plains, moraines, and bottom land. These soils formed in alluvium and in the underlying organic material. Slopes range from 0 to 2 percent.

Wallkill soils are similar to Coesse soils and are adjacent to Saranac soils. Coesse soils formed in alluvium over a buried mineral soil. Saranac soils have more clay than the Wallkill soils and are not underlain by organic material. They are next to streams.

Typical pedon of Wallkill silty clay loam, in a cultivated field; 925 feet south and 225 feet east of the northwest corner of sec. 12, T. 31 N., R. 8 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silty clay loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

Cg—8 to 21 inches; dark grayish brown (10YR 4/2) silty clay loam; common medium faint brown (10YR 4/3) mottles; weak medium granular structure; friable; common fine roots; medium acid; clear wavy boundary.

Oa1—21 to 26 inches; sapric material, very dark grayish brown (10YR 3/2) broken face, rubbed, and pressed; about 20 percent fiber, 7 percent rubbed; weak medium granular structure; very friable; fine roots; herbaceous fibers; about 20 percent mineral material; slightly acid; clear wavy boundary.

Oa2—26 to 39 inches; sapric material, black (10YR 2/1) broken face, rubbed, and pressed; about 50 percent fiber, 5 percent rubbed; massive; very friable; few fine roots; herbaceous fibers; about 2 percent mineral material; medium acid; gradual wavy boundary.

Oa3—39 to 60 inches; sapric material, very dark grayish brown (2.5Y 3/2) broken face, rubbed, and pressed; about 40 percent fiber, 7 percent rubbed; massive; very friable; herbaceous fibers; about 2 percent mineral material; slightly acid.

The mineral material is 16 to 40 inches thick. The organic material is at least 16 inches thick. The fiber in the organic material is derived primarily from herbaceous plants. Reaction is medium acid to neutral throughout the profile.

The A and C horizons are silt loam, silty clay loam, or loam. The A horizon has value of 3 or 4 and chroma of 1 or 2. The C horizon has value of 3 to 5 and chroma of 1 or 2. The O horizon has hue of 5YR to 2.5Y or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2.

Wawasee Series

The Wawasee series consists of deep, well drained, moderately permeable soils on moraines. These soils formed in glacial till. Slopes range from 2 to 15 percent.

Wawasee soils are similar to Miami and Riddles soils and are adjacent to Brookston and Crosier soils. Miami soils have more clay in the solum than the Wawasee soils. Riddles soils have a solum that is thicker than that of the Wawasee soils. The very poorly drained Brookston and somewhat poorly drained Crosier soils are on foot slopes, in nearly level areas, and in depressions. They have mottles in the upper part of the subsoil.

Typical pedon of Wawasee sandy loam, 2 to 6 percent slopes, in a cultivated field; 1,800 feet south and 2,475 feet west of the northeast corner of sec. 6, T. 31 N., R. 8 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) sandy loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; common fine roots; neutral; abrupt smooth boundary.

Bt1—9 to 13 inches; yellowish brown (10YR 5/4) loam; moderate fine subangular blocky structure; firm; few fine roots; thin patchy dark yellowish brown (10YR 4/4) clay films on faces of peds; thin continuous pale brown (10YR 6/3) silt coatings on faces of peds; few glacial pebbles; slightly acid; clear wavy boundary.

Bt2—13 to 19 inches; yellowish brown (10YR 5/4) loam; moderate medium subangular blocky structure; firm; few fine roots; thin continuous dark yellowish brown (10YR 4/4) clay films on faces of peds; thin discontinuous pale brown (10YR 6/3) silt coatings on faces of peds; few glacial pebbles; slightly acid; clear wavy boundary.

Bt3—19 to 23 inches; yellowish brown (10YR 5/6) clay loam; moderate coarse subangular blocky structure; firm; thin continuous dark brown (7.5YR 4/4) clay films on faces of peds; thin patchy pale brown (10YR 6/3) silt coatings on faces of peds; few glacial pebbles; slightly acid; clear wavy boundary.

Bt4—23 to 31 inches; yellowish brown (10YR 5/6) loam; weak coarse subangular blocky structure; firm; thin continuous dark brown (7.5YR 4/4) clay films on faces of peds; few glacial pebbles; neutral; clear wavy boundary.

C—31 to 60 inches; yellowish brown (10YR 5/4) sandy loam; massive; firm; thin discontinuous pale brown (10YR 6/3) calcium carbonate deposits in vertical cracks; few glacial pebbles; strong effervescence; moderately alkaline.

The solum is 28 to 40 inches thick. The Ap horizon has value of 4 or 5 and chroma of 2 or 3. Pedons in areas that have not been cultivated have an A horizon, which has hue of 10YR, value of 3, and chroma of 1 to 3. The Ap or A horizon is sandy loam, loam, or sandy clay loam. It is neutral or slightly acid.

Some pedons have an E horizon. This horizon has hue of 10YR, value of 5 or 6, and chroma of 2 to 4. It is loam or sandy loam. It is neutral to medium acid.

The Bt horizon has value of 4 or 5 and chroma of 3 to 6. It is loam, sandy clay loam, or clay loam. It is neutral to medium acid. Some pedons have a BC horizon. This horizon is loam or sandy loam. It is neutral to mildly alkaline.

The C horizon has value of 5 or 6 and chroma of 3 to 6. It is loam or sandy loam. It is neutral to moderately alkaline.

Whitaker Series

The Whitaker series consists of deep, somewhat poorly drained, moderately permeable soils on river terraces and outwash plains. These soils formed in stratified, loamy and sandy outwash. Slopes range from 0 to 2 percent.

Whitaker soils are similar to Crosier, Fulton, Haskins, Homer, and Shoals soils and are commonly adjacent to Martinsville and Rensselaer soils. Crosier and Haskins soils are underlain by glacial till. Fulton soils have more clay and less sand in the upper part of the solum than the Whitaker soils. Homer soils have a solum that is thinner than that of the Whitaker soils and have more gravel in the lower part of the solum and in the underlying material. Shoals soils do not have a subsoil. Martinsville soils are well drained and are on rises and in the more sloping areas. They are not mottled in the upper part of the subsoil. Rensselaer soils are very poorly drained and are in depressions. They have a thick surface layer that is darker than that of the Whitaker soils.

Typical pedon of Whitaker loam, in a cultivated field; 125 feet north and 1,060 feet west of the center of sec. 36, T. 32 N., R. 10 E.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; common medium and fine roots; slightly acid; abrupt smooth boundary.

E—10 to 14 inches; grayish brown (10YR 5/2) loam; common fine distinct yellowish brown (10YR 5/4) mottles; moderate coarse granular structure; friable; common fine roots; thin continuous gray (10YR 5/1) silt coatings on faces of peds; slightly acid; clear wavy boundary.

Bt—14 to 28 inches; yellowish brown (10YR 5/6) clay loam; many medium distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; common fine roots; thin discontinuous dark grayish brown (10YR 4/2) clay films on faces of peds; thin continuous gray (10YR 5/1) silt coatings on faces of peds; medium acid; clear wavy boundary.

Btg1—28 to 37 inches; dark grayish brown (10YR 4/2) sandy clay loam; many fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; friable; few fine roots; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; few black (10YR 2/1) accumulations of iron and manganese oxide; medium acid; clear smooth boundary.

Btg2—37 to 45 inches; grayish brown (10YR 5/2) clay loam; many fine distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; few fine roots; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; few black (10YR 2/1) accumulations of iron and manganese oxide; neutral; clear wavy boundary.

Btg3—45 to 51 inches; grayish brown (10YR 5/2) clay loam; many medium distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; thin continuous very dark brown (10YR 2/2) organic coatings in old root channels; few black (10YR 2/1) accumulations of iron and manganese oxide; neutral; clear wavy boundary.

BCg—51 to 58 inches; gray (10YR 5/1) loam; many medium distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; friable; neutral; clear wavy boundary.

Cg—58 to 70 inches; grayish brown (10YR 5/2) stratified loamy fine sand and fine sand; few coarse faint brown (10YR 5/3) mottles; single grain; loose; strong effervescence; moderately alkaline.

The solum is 40 to 60 inches thick. The Ap horizon has value of 4 or 5 and chroma of 2 or 3. Pedons in undisturbed areas have an A horizon, which has hue of 10YR, value of 3, and chroma of 1 or 2. The Ap or A horizon is loam, silt loam, or sandy loam. It is neutral to medium acid. Some pedons have an E horizon, which has chroma of 2 or 3. The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 6. It is dominantly loam, clay loam, or sandy clay loam, but in some pedons it has subhorizons of silty clay loam or sandy loam. It is strongly acid to neutral. The C horizon is stratified fine sandy loam to sand. It is neutral to moderately alkaline.

Formation of the Soils

This section relates the major factors of soil formation to the soils in the county. It also describes the processes of soil formation.

Factors of Soil Formation

Soils form through the physical and chemical weathering of geologic material. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material; the climate under which the soil material accumulated and has existed since accumulation; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time that 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 into a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material affects the kind of soil profile that forms. Finally, time is needed for the transformation of the parent material into a soil that has genetically related horizons. Some time is always required for the differentiation of 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.

Parent Material

Parent material is the unconsolidated mass in which a soil forms. It determines the limits of the chemical and mineralogical composition of the soil. The parent materials of the soils in Whitley County generally were deposited by glaciers or by meltwater from the glaciers. Some of these materials were reworked and redeposited by the subsequent actions of water and wind. The glaciers covered the county for thousands of years. The last one retreated from the county about 15,000 years ago. Although the parent materials are mainly of glacial origin, their properties vary greatly, sometimes within small areas, depending on how the materials were deposited. The parent materials in the county were deposited as glacial till, outwash, loess, lacustrine material, 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. Many of the small pebbles in glacial till have sharp corners and edges, indicating that they have not been worn by water. The glacial till in Whitley County is calcareous, firm sandy loam, loam, and clay loam. Soils that formed in glacial till are loamy and have well developed structure. Miami soils are an example.

Outwash material was deposited by running water from melting glaciers. The size of the particles that make up outwash varies, depending on the velocity of the water that carried the material. When the water slowed down, the coarser particles were deposited. Finer particles, such as very fine sand, silt, and clay, were carried farther by the more slowly moving water. Outwash deposits generally occur as layers of similar-size particles, such as loam, sandy loam, sand, gravel, and other coarse particles. Boyer soils are an example of soils that formed in outwash material.

Loess consists of dominantly silt-sized particles deposited by the wind. It was deposited after the glaciers receded. Thin deposits of loess are on uplands. They affect only the surface textures of some soils.

Lacustrine material was deposited from still, or ponded, glacial meltwater. Because the coarser particles dropped out of moving water as outwash, only the finer particles, such as very fine sand, silt, and clay, remained to settle out in still water. Lacustrine deposits are silty or clayey. The soils in Whitley County that formed in lacustrine deposits typically have a surface layer of silty clay loam. Milford soils are an example.

Alluvial material was recently deposited by floodwater along present streams. This material varies in texture, depending on the velocity of the water from which it was deposited. The alluvial material deposited along a swift stream, such as the lower reaches of the Eel River, is coarser textured than that deposited along a slow, sluggish stream, such as the Blue River. Shoals and Sloan are examples of soils that formed in alluvium.

Organic material is made up of plant remains. After the glaciers receded, lakes formed as water was left standing in depressions on outwash plains and till plains. Grasses and sedges growing around the edges of these lakes died, and their remains fell to the bottom. Later, water-tolerant trees grew in the areas. As the trees died, their remains became part of the organic accumulation.

The lakes gradually filled with organic material, or peat. In some areas the plant remains subsequently decomposed into muck. Houghton soils are an example of soils that formed in organic material.

Plant and Animal Life

Plants have been the principal living organisms affecting the soils in Whitley County. Bacteria, fungi, and earthworms, however, also have been important. The chief contribution of plant and animal life to soil formation is the addition of organic matter and nitrogen to the soil. The kind of organic material on and in the soil depends on the kinds of native plants that grew on the soil. The remains of these plants accumulated on the surface, decayed, and eventually became organic matter in the soil. Plant roots provided channels for the downward movement of water through the soil and added organic matter as they decayed. Bacteria in the soil helped to break down the organic matter into plant nutrients.

The native vegetation in Whitley County was mainly deciduous trees (fig. 15). Differences in natural drainage and minor variations in the kind of parent material affected the composition of the forest species. The well drained upland soils, such as Miami, Morley, and Riddles soils, mainly supported sugar maple, beech, black walnut, yellow-poplar, and red oak. The wet soils primarily supported silver maple, swamp white oak, and sycamore. In a few wet areas sphagnum and other mosses contributed substantially to the accumulation of organic matter. Milford and Pewamo soils formed under wet conditions and contain a relatively large amount of organic matter.

Climate

Climate helps to determine the kind of plant and animal life on and in the soil and the amount of water available for the weathering of minerals and for the removal and translocation of the products of weathering. Through its influence on soil temperature, climate determines the rate of chemical reactions that occur in the soil. These influences are important, but they affect large areas rather than a relatively small area, such as a county.

The climate in Whitley County is cool and humid. It is presumably similar to the climate under which the soils formed. The climate is fairly uniform throughout the county. Only minor differences among the soils are the result of climatic differences.

Relief

Relief has markedly affected the soils in Whitley County through its effect on the depth to the water table, erosion, runoff, plant cover, and soil temperature. Slopes range from nearly level to steep. Runoff is most rapid on the steeper slopes. Water is temporarily ponded in the lower areas.

Natural soil drainage in the county ranges from well drained on ridgetops to very poorly drained in depressions. Through its effect on aeration of the soil, drainage determines the color of the soil. Water and air move freely through well drained soils but slowly through very poorly drained soils. In Boyer and other well drained, well aerated soils, the iron compounds that give most soils their color are oxidized and brightly colored. Milford and other very poorly drained, poorly aerated soils are dull gray and mottled.

Time

Generally, a long time is required for the processes of soil formation to change the parent material into a soil that has distinct horizons. Differences in the length of time that the parent material has been in place are commonly reflected in the degree of profile development. Some soils form rapidly. Others form slowly.

The soils in Whitley County range from young to mature. The glacial deposits in which many of the soils in the county formed have been exposed to soil-forming factors long enough for the development of distinct horizons. Some soils, however, have not been in place long enough for distinct horizons to develop. Examples are Shoals and other soils that formed in recent alluvial sediments.

Processes of Soil Formation

Several processes have been involved in the formation of the soils in Whitley County. These processes are the accumulation of organic matter; the dissolution, transfer, and removal of calcium carbonates and bases; the liberation and translocation of silicate clay minerals; and the reduction and transfer of iron. In most soils more than one of these processes have helped to differentiate horizons. The leaching of bases and the translocation of silicate clays are among the more important processes of horizon differentiation in Whitley County.

Some organic matter has accumulated in the surface layer of all the soils in the county. The content of organic matter in some soils is low, but that in others is high. Generally, the soils that have the highest content of organic matter, such as Pewamo or Rensselaer soils, have a thick, dark surface soil.

Carbonates and bases have been leached from the upper horizons of nearly all the soils in the county. Leaching probably preceded the translocation of silicate clay minerals. Most of the carbonates and some of the bases have been leached from the A, E, and B horizons in well drained soils. Even in the wettest soils, some leaching is indicated by the absence of carbonates and by an acid reaction. Leaching is slow in wet soils because the water table is high or because water moves slowly through these soils.

Figure 15.—Native deciduous trees on Morley soils.

Silicate clays accumulate in pores and on the faces of the structural units along which water moves. Morley soils are an example of soils in which translocated silicate clays in the form of clay films have accumulated in the Bt horizon.

Gleying, or the reduction and transfer of iron, has occurred in all of the very poorly drained and somewhat poorly drained soils in the county. This process has significantly affected horizon differentiation in these soils. It is evidenced by a grayish color in the subsoil. Reduction commonly is accompanied by some transfer of iron, either from upper horizons to lower ones or completely out of the profile. Mottles indicate the redistribution and segregation of iron.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

Ablation till. Loose, permeable till deposited during the final downwasting of glacial ice. Lenses of crudely sorted sand and gravel are common.

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.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

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

Basal till. Compact glacial till deposited beneath the ice.

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.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

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 compacted layers to a depth 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 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

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 a protective amount of 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.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms.

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.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

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 frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

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.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

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.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

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 meltwater.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

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 7.6 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 (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

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.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

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 uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

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, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon 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) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

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 overlying 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, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock 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.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

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.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

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. Coarse sandy loam, 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.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

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.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

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 0.2 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.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

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.

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.

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.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Root zone. The part of the soil that can be penetrated by plant roots.

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.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

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.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

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.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters 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, E, 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.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to soil blowing and water erosion.

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 grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

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.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

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.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Underlying material. The part of the soil below the solum.

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.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1963-74 at Columbia City, Indiana)

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	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*	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-----	30.7	12.6	21.7	60	-16	8	1.87	0.74	2.82	5	6.4
February----	34.5	16.5	25.5	58	-11	0	2.14	1.01	3.10	6	6.4
March-------	45.4	26.5	36.0	75	8	120	2.72	1.80	3.56	8	6.9
April-------	58.5	36.2	47.4	83	21	226	3.44	2.22	4.54	9	1.0
May---------	69.1	45.7	57.4	89	29	549	3.98	2.98	4.92	8	.0
June--------	80.6	56.6	68.6	95	41	858	3.54	2.14	4.78	7	.0
July--------	82.4	59.5	71.0	95	44	961	4.27	2.62	5.75	8	.0
August------	81.1	57.8	69.5	93	41	915	3.61	2.42	4.68	7	.0
September---	75.8	51.0	63.4	90	33	702	3.28	1.12	5.05	7	.0
October-----	64.9	40.9	52.9	85	23	410	2.68	.63	4.30	6	.0
November----	48.4	31.6	40.0	74	13	89	3.10	2.08	4.02	7	2.0
December----	35.6	20.9	28.3	62	-4	19	3.01	1.21	4.51	6	7.5
Yearly:											
Average---	58.9	38.0	48.5	---	---	---	---	---	---	---	---
Extreme---	---	---	---	95	-16	---	---	---	---	---	---
Total-----	---	---	---	---	---	4,857	37.64	33.95	46.49	84	30.2

* 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 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1963-74 at Columbia City, Indiana)

Probability	Temperature: 24^{o} F or lower	Temperature: 28^{o} F or lower	Temperature: 32^{o} F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 17	May 4	May 16
2 years in 10 later than--	Apr. 13	Apr. 28	May 12
5 years in 10 later than--	Apr. 6	Apr. 18	May 3
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 18	Oct. 5	Sept. 23
2 years in 10 earlier than--	Oct. 23	Oct. 11	Sept. 29
5 years in 10 earlier than--	Nov. 2	Oct. 23	Oct. 11

TABLE 3.--GROWING SEASON

(Recorded in the period 1963-74 at Columbia City, Indiana)

Probability	Daily minimum temperature during growing season: Higher than 24^{o} F	Higher than 28^{o} F	Higher than 32^{o} F
	Days	Days	Days
9 years in 10	192	160	140
8 years in 10	198	170	147
5 years in 10	210	187	160
2 years in 10	221	205	173
1 year in 10	227	214	179

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Ae	Adrian muck, drained	355	0.2
BmA	Blount silt loam, 0 to 2 percent slopes	17,500	8.1
BmB2	Blount silt loam, 1 to 4 percent slopes, eroded	29,500	13.6
Bt	Boots muck, undrained	295	0.1
BvB	Boyer loamy sand, 2 to 6 percent slopes	320	0.1
BvC	Boyer loamy sand, 6 to 12 percent slopes	385	0.2
BvD	Boyer loamy sand, 12 to 20 percent slopes	560	0.3
BwA	Boyer sandy loam, 0 to 2 percent slopes	560	0.3
BwB	Boyer sandy loam, 2 to 6 percent slopes	1,550	0.7
BwC	Boyer sandy loam, 6 to 12 percent slopes	650	0.3
ByC3	Boyer loam, 6 to 15 percent slopes, severely eroded	435	0.2
Bz	Brookston loam	520	0.2
Co	Coesse silty clay loam	3,900	1.8
CsA	Crosier sandy loam, 0 to 3 percent slopes	455	0.2
Fu	Fulton silty clay loam	200	0.1
GsB2	Glynwood loam, 3 to 6 percent slopes, eroded	19,300	8.9
GtB3	Glynwood clay loam, 3 to 8 percent slopes, severely eroded	2,900	1.3
Gw	Granby loamy sand	300	0.1
HbA	Haskins loam, 0 to 3 percent slopes	6,400	3.0
HeG	Hennepin loam, 25 to 50 percent slopes	1,100	0.5
Ho	Homer loam	350	0.2
Hs	Houghton muck, undrained	2,300	1.1
Ht	Houghton muck, drained	2,950	1.4
KaA	Kalamazoo sandy loam, 0 to 2 percent slopes	770	0.3
KaB	Kalamazoo sandy loam, 2 to 6 percent slopes	360	0.2
MbB	Martinsville loam, 1 to 6 percent slopes	580	0.3
MbC	Martinsville loam, 6 to 15 percent slopes	235	0.1
Md	Martisco muck, drained	430	0.2
Mg	Mermill loam	3,400	1.6
MmB2	Miami sandy loam, 2 to 6 percent slopes, eroded	1,250	0.6
MmC2	Miami sandy loam, 6 to 12 percent slopes, eroded	730	0.3
MmD2	Miami sandy loam, 12 to 18 percent slopes, eroded	420	0.2
MmE2	Miami sandy loam, 18 to 25 percent slopes, eroded	200	0.1
MoC3	Miami clay loam, 6 to 12 percent slopes, severely eroded	600	0.3
MoD3	Miami clay loam, 12 to 20 percent slopes, severely eroded	600	0.3
Ms	Milford silty clay loam	2,150	1.0
MvB2	Morley loam, 3 to 6 percent slopes, eroded	14,400	6.7
MvC2	Morley loam, 6 to 12 percent slopes, eroded	6,300	2.9
MvD2	Morley loam, 12 to 20 percent slopes, eroded	3,350	1.5
MvE2	Morley loam, 20 to 30 percent slopes, eroded	1,850	0.9
MxC3	Morley clay loam, 5 to 12 percent slopes, severely eroded	17,200	8.0
MxD3	Morley clay loam, 12 to 20 percent slopes, severely eroded	7,800	3.6
MxE3	Morley clay loam, 20 to 30 percent slopes, severely eroded	730	0.3
Mz	Muskego muck, clay loam substratum, drained	820	0.4
OmB	Ormas loamy fine sand, 0 to 4 percent slopes	500	0.2
OsA	Oshtemo sandy loam, 0 to 2 percent slopes	400	0.2
Pa	Palms muck, sandy substratum, undrained	200	0.1
Pb	Palms muck, sandy substratum, drained	440	0.2
Pw	Pewamo silty clay loam	25,500	11.8
Px	Pits, gravel	340	0.2
RcA	Rawson sandy loam, 0 to 2 percent slopes	850	0.4
RcB	Rawson sandy loam, 2 to 6 percent slopes	6,700	3.1
RcC	Rawson sandy loam, 6 to 12 percent slopes	1,650	0.8
Re	Rensselaer loam	1,950	0.9
RhB	Riddles sandy loam, 1 to 6 percent slopes	710	0.3
RhC	Riddles sandy loam, 6 to 12 percent slopes	260	0.1
Sa	Saranac silty clay loam, sandy substratum, frequently flooded	1,350	0.6
Se	Sebewa loam	740	0.3
SfB	Seward loamy fine sand, 2 to 6 percent slopes	415	0.2
SfC	Seward loamy fine sand, 6 to 15 percent slopes	210	0.1
Sh	Shoals silt loam, sandy substratum, frequently flooded	4,150	1.9
So	Sloan loam, sandy substratum, frequently flooded	5,100	2.4
SpB	Spinks sand, 2 to 6 percent slopes	395	0.2
SpC	Spinks sand, 6 to 15 percent slopes	380	0.2
St	Stonelick Variant sandy loam, occasionally flooded	300	0.1

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
Ud	Udorthents, loamy	750	0.3
Wa	Wallkill silty clay loam	2,400	1.1
Wc	Wallkill silty clay loam, coprogenous earth substratum	201	0.1
WmB	Wawasee sandy loam, 2 to 6 percent slopes	400	0.2
WmC	Wawasee sandy loam, 6 to 15 percent slopes	285	0.1
Wt	Whitaker loam	455	0.2
	Water areas greater than 40 acres in size	1,350	0.6
	Water areas less than 40 acres in size	870	0.4
	Total	216,211	100.0

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
BmA	Blount silt loam, 0 to 2 percent slopes (where drained)
BmB2	Blount silt loam, 1 to 4 percent slopes, eroded (where drained)
BwA	Boyer sandy loam, 0 to 2 percent slopes
BwB	Boyer sandy loam, 2 to 6 percent slopes
Bz	Brookston loam (where drained)
Co	Coesse silty clay loam (where drained)
CsA	Crosier sandy loam, 0 to 3 percent slopes (where drained)
Fu	Fulton silty clay loam (where drained)
GsB2	Glynwood loam, 3 to 6 percent slopes, eroded
HbA	Haskins loam, 0 to 3 percent slopes (where drained)
Ho	Homer loam (where drained)
KaA	Kalamazoo sandy loam, 0 to 2 percent slopes
KaB	Kalamazoo sandy loam, 2 to 6 percent slopes
MbB	Martinsville loam, 1 to 6 percent slopes
Mg	Mermill loam (where drained)
MmB2	Miami sandy loam, 2 to 6 percent slopes, eroded
Ms	Milford silty clay loam (where drained)
MvB2	Morley loam, 3 to 6 percent slopes, eroded
OsA	Oshtemo sandy loam, 0 to 2 percent slopes
Pw	Pewamo silty clay loam (where drained)
RcA	Rawson sandy loam, 0 to 2 percent slopes
RcB	Rawson sandy loam, 2 to 6 percent slopes
Re	Rensselaer loam (where drained)
RhB	Riddles sandy loam, 1 to 6 percent slopes
Sa	Saranac silty clay loam, sandy substratum, frequently flooded (where drained and either protected from flooding or not frequently flooded during the growing season)
Se	Sebewa loam (where drained)
Sh	Shoals silt loam, sandy substratum, frequently flooded (where drained and either protected from flooding or not frequently flooded during the growing season)
So	Sloan loam, sandy substratum, frequently flooded (where drained and either protected from flooding or not frequently flooded during the growing season)
St	Stonelick Variant sandy loam, occasionally flooded
WmB	Wawasee sandy loam, 2 to 6 percent slopes
Wt	Whitaker loam (where drained)

TABLE 6.--LAND CAPABILITY CLASSES AND 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	Land capability	Corn	Soybeans	Winter wheat	Orchardgrass-alfalfa hay	Tall fescue
		Bu	Bu	Bu	Tons	AUM*
Ae----------------------- Adrian	IVw	95	33	---	2.4	4.8
BmA---------------------- Blount	IIw	108	38	50	4.3	7.2
BmB2--------------------- Blount	IIe	98	35	47	4.1	6.9
Bt----------------------- Boots	VIw	---	---	---	---	---
BvB---------------------- Boyer	IIIs	78	28	32	2.6	5.2
BvC---------------------- Boyer	IIIe	70	25	28	2.5	5.0
BvD---------------------- Boyer	IVe	55	21	24	2.0	4.0
BwA, BwB----------------- Boyer	IIIs	88	30	35	3.4	6.8
BwC---------------------- Boyer	IIIe	77	26	32	2.8	5.6
ByC3--------------------- Boyer	IVe	65	20	28	2.2	4.4
Bz----------------------- Brookston	IIw	140	48	65	4.8	9.6
Co----------------------- Coesse	IIw	128	38	48	4.2	8.4
CsA---------------------- Crosier	IIw	120	42	54	4.0	8.0
Fu----------------------- Fulton	IIIw	110	40	44	4.0	8.0
GsB2--------------------- Glynwood	IIe	95	32	38	4.0	8.0
GtB3--------------------- Glynwood	IIIe	82	28	33	3.5	7.0
Gw----------------------- Granby	IVw	108	38	43	3.3	6.6
HbA---------------------- Haskins	IIw	115	42	46	4.2	8.4
HeG---------------------- Hennepin	VIIe	---	---	---	1.2	2.4

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Winter wheat	Orchardgrass-alfalfa hay	Tall fescue
		Bu	Bu	Bu	Tons	AUM*
Ho------------------------ Homer	IIw	105	37	52	3.3	6.6
Hs------------------------ Houghton	Vw	---	---	---	---	---
Ht------------------------ Houghton	IIIw	115	38	---	3.0	6.0
KaA----------------------- Kalamazoo	IIs	95	34	47	3.8	7.6
KaB----------------------- Kalamazoo	IIe	92	32	46	3.6	7.2
MbB----------------------- Martinsville	IIe	120	42	50	4.0	8.0
MbC----------------------- Martinsville	IIIe	110	38	48	3.6	7.2
Md------------------------ Martisco	IIIw	88	32	---	2.8	5.6
Mg------------------------ Mermill	IIw	135	46	54	5.0	10.0
MmB2---------------------- Miami	IIe	105	37	47	3.4	6.8
MmC2---------------------- Miami	IIIe	95	33	43	3.1	6.2
MmD2---------------------- Miami	IVe	82	30	36	2.6	5.2
MmE2---------------------- Miami	VIe	---	---	---	2.3	4.6
MoC3---------------------- Miami	IVe	85	32	40	3.0	6.0
MoD3---------------------- Miami	VIe	---	---	---	2.5	5.0
Ms------------------------ Milford	IIw	123	40	50	4.8	9.6
MvB2---------------------- Morley	IIe	93	32	37	4.1	8.2
MvC2---------------------- Morley	IIIe	85	30	34	4.0	8.0
MvD2---------------------- Morley	IVe	78	27	31	3.6	7.2
MvE2---------------------- Morley	VIe	---	---	---	3.1	6.2

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Winter wheat	Orchardgrass-alfalfa hay	Tall fescue
		Bu	Bu	Bu	Tons	AUM*
MxC3---------------------- Morley	IVe	77	27	31	3.6	7.2
MxD3---------------------- Morley	VIe	---	---	---	3.3	6.6
MxE3---------------------- Morley	VIIe	---	---	---	3.0	6.0
Mz------------------------ Muskego	IVw	100	35	---	3.0	6.0
OmB----------------------- Ormas	IIIs	80	23	30	2.0	4.0
OsA----------------------- Oshtemo	IIIs	95	33	45	2.5	5.0
Pa------------------------ Palms	VIw	---	---	---	---	---
Pb------------------------ Palms	IIIw	105	35	---	3.0	6.0
Pw------------------------ Pewamo	IIw	130	44	60	5.0	10.0
Px**. Pits						
RcA----------------------- Rawson	I	105	38	46	4.2	8.4
RcB----------------------- Rawson	IIe	100	35	42	4.0	8.0
RcC----------------------- Rawson	IIIe	90	31	36	3.8	7.6
Re------------------------ Rensselaer	IIw	145	50	58	5.0	10.0
RhB----------------------- Riddles	IIe	115	40	46	4.1	8.2
RhC----------------------- Riddles	IIIe	105	37	42	3.8	7.6
Sa------------------------ Saranac	IIIw	128	44	51	3.5	7.0
Se------------------------ Sebewa	IIw	123	43	50	4.6	9.2
SfB----------------------- Seward	IIe	95	33	38	3.5	7.0
SfC----------------------- Seward	IIIe	85	30	34	3.0	6.0

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Winter wheat	Orchardgrass-alfalfa hay	Tall fescue
		Bu	Bu	Bu	Tons	AUM*
Sh----------------------- Shoals	IIIw	117	41	47	4.0	8.0
So----------------------- Sloan	IIIw	128	44	---	4.0	8.0
SpB---------------------- Spinks	IIIs	65	23	26	3.0	6.0
SpC---------------------- Spinks	IIIe	60	21	24	2.4	4.8
St----------------------- Stonelick Variant	IIw	95	30	40	3.8	7.6
Ud**. Udorthents						
Wa----------------------- Wallkill	IIIw	130	45	55	4.5	9.0
Wc----------------------- Wallkill	IIIw	95	37	46	4.0	8.0
WmB---------------------- Wawasee	IIe	105	37	47	3.4	6.8
WmC---------------------- Wawasee	IIIe	95	33	40	3.1	6.2
Wt----------------------- Whitaker	IIw	125	44	50	4.1	8.2

* 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.

** See description of the map unit for composition and behavior characteristics of the map unit.

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)	Climate (c)
		Acres	Acres	Acres	Acres
I	850	---	---	---	---
II	138,005	73,615	63,620	770	---
III	34,501	13,985	16,791	3,725	---
IV	24,470	22,565	1,905	---	---
V	2,300	---	2,300	---	---
VI	10,945	10,450	495	---	---
VII	1,830	1,830	---	---	---
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	Ordi-nation symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equip-ment limita-tion	Seedling mortal-ity	Wind-throw hazard	Common trees	Site index	Volume*	
Ae------------- Adrian	2W	Slight	Severe	Severe	Severe	White ash-----------	51	28	
						Red maple-----------	51	28	
						Quaking aspen-------	56	56	
						Black willow--------	---	---	
						Silver maple--------	76	30	
BmA, BmB2------- Blount	3C	Slight	Slight	Severe	Severe	White oak-----------	65	48	Eastern white pine, red pine, yellow-poplar.
						Northern red oak----	65	48	
						Green ash-----------	---	---	
						Bur oak-------------	---	---	
						Pin oak-------------	---	---	
Bt------------- Boots	3W	Slight	Severe	Severe	Severe	Tamarack------------	50	42	
BvB, BvC-------- Boyer	4S	Slight	Slight	Moderate	Slight	White oak-----------	70	52	Eastern white pine, red pine, jack pine.
						Red pine------------	75	142	
						Eastern white pine--	65	136	
						Jack pine-----------	68	100	
						Northern red oak----	75	57	
BvD------------- Boyer	4R	Moderate	Moderate	Moderate	Slight	White oak-----------	70	52	Eastern white pine, red pine, jack pine.
						Red pine------------	75	142	
						Eastern white pine--	65	136	
						Jack pine-----------	68	100	
						Northern red oak----	75	57	
BwA, BwB, BwC, ByC3----------- Boyer	4A	Slight	Slight	Slight	Slight	White oak-----------	70	52	Eastern white pine, red pine, jack pine.
						Red pine------------	75	142	
						Eastern white pine--	65	136	
						Jack pine-----------	68	100	
						Northern red oak----	75	57	
Bz-------------- Brookston	5W	Slight	Severe	Severe	Moderate	Pin oak-------------	86	68	Eastern white pine, red maple, white ash.
						White oak-----------	75	57	
						Sweetgum------------	90	106	
						Northern red oak----	78	60	
Co-------------- Coesse	5W	Slight	Severe	Severe	Severe	Pin oak-------------	85	67	White ash, swamp white oak, green ash, eastern white pine.
						Red maple-----------	70	55	
						Swamp white oak-----	---	---	
						White ash-----------	---	---	
						American sycamore---	---	---	
						Silver maple--------	---	---	
						Eastern cottonwood--	---	---	

See footnote at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

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	Potential productivity: Volume*	Trees to plant
CsA------------- Crosier	4A	Slight	Slight	Slight	Slight	White oak----------- Pin oak------------- Yellow-poplar------- Sweetgum------------ Northern red oak----	75 85 85 80 75	57 67 81 79 57	Eastern white pine, white ash, red maple, yellow-poplar, American sycamore.
Fu-------------- Fulton	4C	Slight	Moderate	Moderate	Severe	Pin oak------------- American beech------ White oak----------- White ash----------- Black cherry-------- Slippery elm-------- Red maple-----------	80 --- --- --- --- --- ---	62 --- --- --- --- --- ---	Red maple, Austrian pine, green ash, black oak, yellow-poplar, pin oak, American sycamore, eastern cottonwood.
GsB2, GtB3------ Glynwood	4C	Slight	Slight	Moderate	Moderate	Northern red oak---- Black oak----------- White oak----------- Red maple----------- Slippery elm-------- Black cherry-------- White ash-----------	80 80 80 --- --- --- ---	62 62 62 --- --- --- ---	Austrian pine, yellow-poplar, green ash, pin oak, red maple, black oak, American sycamore, eastern cottonwood.
Gw-------------- Granby	4W	Slight	Severe	Severe	Severe	Pin oak------------- Quaking aspen------- Eastern white pine--	70 70 75	52 81 166	Eastern white pine, European larch, black spruce.
HbA------------- Haskins	4A	Slight	Slight	Slight	Slight	White oak----------- Northern red oak---- Pin oak------------- Yellow-poplar------- Black cherry-------- Sugar maple--------- White ash-----------	75 80 90 --- --- --- ---	57 62 72 --- --- --- ---	Green ash, white ash, eastern white pine, yellow-poplar, black cherry, red pine, northern red oak, white oak, American sycamore, eastern cottonwood.
HeG------------- Hennepin	5R	Moderate	Moderate	Slight	Slight	Northern red oak---- White oak-----------	85 ---	67 ---	Northern red oak, white oak, green ash, black walnut, eastern white pine, red pine, eastern redcedar.

See footnote at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
Ho----------- Homer	4A	Slight	Slight	Slight	Slight	White oak-----------	70	52	Eastern white pine, white ash, red maple, yellow-poplar, American sycamore.
						Pin oak-------------	85	67	
						Yellow-poplar-------	85	81	
						Sweetgum------------	80	79	
Hs, Ht---------- Houghton	2W	Slight	Severe	Severe	Severe	White ash-----------	51	35	
						Red maple-----------	51	28	
						Black willow--------	---	---	
						Quaking aspen-------	56	56	
						Silver maple--------	76	30	
KaA, KaB-------- Kalamazoo	3A	Slight	Slight	Slight	Slight	Northern red oak----	65	48	Black walnut, yellow-poplar, eastern white pine, white spruce, red pine, Carolina poplar.
						White ash-----------	65	59	
						Black walnut--------	65	---	
						Yellow-poplar-------	65	45	
						White oak-----------	---	---	
						Black cherry--------	---	---	
						American basswood---	65	59	
						Sugar maple---------	61	43	
MbB, MbC-------- Martinsville	4A	Slight	Slight	Slight	Slight	White oak-----------	80	62	Eastern white pine, red pine, white ash, yellow-poplar, black walnut.
						Yellow-poplar-------	98	104	
						Sweetgum------------	76	70	
Md-------------- Martisco	4W	Slight	Severe	Severe	Severe	Red maple-----------	55	38	
						Green ash-----------	55	42	
						Quaking aspen-------	56	56	
						Black willow--------	---	---	
						Silver maple--------	---	---	
Mg-------------- Mermill	4W	Slight	Severe	Severe	Severe	Pin oak-------------	90	72	Red maple, swamp white oak, green ash, pin oak, American sycamore, eastern cottonwood.
						Swamp white oak-----	90	72	
						Green ash-----------	---	---	
						Black cherry--------	---	---	
						Eastern cottonwood--	---	---	
						Red maple-----------	---	---	
MmB2, MmC2, MmD2----------- Miami	4A	Slight	Slight	Slight	Slight	White oak-----------	90	72	Eastern white pine, red pine, white ash, yellow-poplar, black walnut.
						Yellow-poplar-------	98	104	
						Sweetgum------------	76	70	
MmE2----------- Miami	4R	Moderate	Moderate	Slight	Slight	White oak-----------	90	72	Eastern white pine, red pine, white ash, yellow-poplar, black walnut.
						Yellow-poplar-------	98	104	
						Sweetgum------------	76	70	

See footnote at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
MoC3, MoD3------ Miami	4A	Slight	Slight	Slight	Slight	White oak-----------	90	72	Eastern white pine, red pine, white ash, yellow-poplar, black walnut.
						Yellow-poplar-------	98	104	
						Sweetgum------------	76	70	
MvB2, MvC2------ Morley	4A	Slight	Slight	Slight	Slight	White oak-----------	80	62	White oak, black walnut, green ash, eastern white pine, red pine, white spruce.
						Northern red oak----	80	62	
						Yellow-poplar-------	90	90	
						Black walnut--------	---	---	
						Bur oak-------------	---	---	
						Shagbark hickory----	---	---	
MvD2, MvE2------ Morley	4R	Moderate	Moderate	Slight	Slight	White oak-----------	80	62	White oak, black walnut, green ash, eastern white pine, red pine, white spruce.
						Northern red oak----	80	62	
						Yellow-poplar-------	90	90	
						Black walnut--------	---	---	
						Bur oak-------------	---	---	
						Shagbark hickory----	---	---	
MxC3------------ Morley	4A	Slight	Slight	Slight	Slight	White oak-----------	80	62	White oak, black walnut, green ash, eastern white pine, red pine, white spruce.
						Northern red oak----	80	62	
						Yellow-poplar-------	90	90	
						Black walnut--------	---	---	
						Bur oak-------------	---	---	
						Shagbark hickory----	---	---	
MxD3, MxE3------ Morley	4R	Moderate	Moderate	Slight	Slight	White oak-----------	80	62	White oak, black walnut, green ash, eastern white pine, red pine, white spruce.
						Northern red oak----	80	62	
						Yellow-poplar-------	90	90	
						Black walnut--------	---	---	
						Bur oak-------------	---	---	
						Shagbark hickory----	---	---	
Mz-------------- Muskego	2W	Slight	Severe	Severe	Severe	White ash-----------	52	37	
						Silver maple--------	---	---	
						Green ash-----------	---	---	
						Eastern cottonwood--	---	---	
						Black willow--------	---	---	
						Quaking aspen-------	56	56	
OmB------------- Ormas	4S	Slight	Slight	Moderate	Slight	White oak-----------	70	52	Eastern white pine, red pine, yellow-poplar, black walnut, European alder.
						Yellow-poplar-------	---	---	
						Eastern white pine--	---	---	
						Red pine------------	78	150	

See footnote at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordi- nation symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equip- ment limita- tion	Seedling mortal- ity	Wind- throw hazard	Common trees	Site index	Volume*	
OsA------------- Oshtemo	4A	Slight	Slight	Slight	Slight	Northern red oak---- White oak----------- American basswood--- Sugar maple---------	66 --- 66 61	48 --- 60 44	Eastern white pine, red pine, white spruce.
Pa, Pb---------- Palms	4W	Slight	Severe	Severe	Severe	White ash----------- Red maple----------- Quaking aspen------- Black willow-------- Silver maple--------	51 51 56 --- 96	35 28 56 --- 30	
Pw-------------- Pewamo	4W	Slight	Severe	Moderate	Moderate	Pin oak------------- Swamp white oak----- Red maple----------- White ash----------- Eastern cottonwood-- Green ash-----------	90 --- 71 71 98 ---	72 --- 54 77 --- ---	White ash, eastern white pine, red maple, green ash.
RcA, RcB, RcC--- Rawson	4A	Slight	Slight	Slight	Slight	White oak----------- Northern red oak---- Yellow-poplar------- Black cherry-------- Sugar maple--------- White ash-----------	75 80 --- --- --- ---	57 62 --- --- --- ---	Eastern white pine, yellow-poplar, black cherry, white ash, red pine, white oak, northern red oak, green ash, American sycamore, eastern cottonwood.
Re-------------- Rensselaer	4W	Slight	Severe	Severe	Severe	Pin oak------------- White oak----------- Sweetgum------------ Northern red oak----	86 75 90 76	68 57 106 58	Eastern white pine, red maple, white ash.
RhB, RhC-------- Riddles	5A	Slight	Slight	Slight	Slight	White oak----------- Yellow-poplar------- Sweetgum------------ Northern red oak----	90 98 76 90	72 104 70 72	Eastern white pine, red pine, white ash, yellow-poplar, black walnut.
Sa-------------- Saranac	4W	Slight	Severe	Severe	Severe	Pin oak------------- Red maple----------- Bur oak------------- White ash----------- Sweetgum------------	85 --- --- --- ---	67 --- --- --- ---	Eastern white pine, red maple, white ash.
Se-------------- Sebewa	4W	Slight	Severe	Severe	Severe	Pin oak------------- White ash----------- White oak----------- Red maple----------- American basswood---	88 75 72 --- ---	70 73 54 --- ---	Eastern white pine, white ash, green ash.

See footnote at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
SfB, SfC: Seward	4S	Slight	Slight	Moderate	Slight	Northern red oak	80	62	Jack pine, yellow-poplar, red pine, black walnut, white ash, black oak, northern red oak.
						Yellow-poplar	95	98	
						Red maple	---	---	
						Black oak	---	---	
						Bur oak	---	---	
						Quaking aspen	---	---	
						Green ash	---	---	
						Slippery elm	---	---	
Sh: Shoals	5W	Slight	Moderate	Slight	Slight	Pin oak	90	72	Red maple, swamp chestnut oak, pin oak, yellow-poplar.
						Sweetgum	86	95	
						Yellow-poplar	90	90	
						Virginia pine	90	135	
So: Sloan	4W	Slight	Severe	Severe	Severe	Pin oak	86	68	Pin oak, American sycamore, eastern cottonwood, red maple, green ash, swamp white oak, silver maple.
						Green ash	---	---	
						Red maple	---	---	
						Swamp white oak	---	---	
						Eastern cottonwood	---	---	
SpB, SpC: Spinks	4S	Slight	Slight	Moderate	Slight	Northern red oak	70	52	Eastern white pine, red pine.
						White oak	66	48	
St: Stonelick Variant	4A	Slight	Slight	Slight	Slight	Northern red oak	75	57	Black walnut, white oak, yellow-poplar, sugar maple, eastern white pine.
						Black walnut	---	---	
						White oak	---	---	
						Sugar maple	---	---	
						Yellow-poplar	---	---	
						American sycamore	---	---	
						Eastern cottonwood	---	---	
Wa: Wallkill	3W	Slight	Severe	Severe	Severe	Pin oak	65	48	Red maple, green ash, eastern cottonwood, pin oak, swamp white oak.
						Red maple	51	28	
						White ash	52	37	
						Quaking aspen	56	56	
						Black willow	---	---	
Wc: Wallkill	3W	Slight	Severe	Severe	Severe	White ash	52	37	Green ash, silver maple, swamp white oak, pin oak.
						Eastern cottonwood	---	---	
						Silver maple	---	---	
						Black willow	---	---	
						Green ash	---	---	
WmB, WmC: Wawasee	5A	Slight	Slight	Slight	Slight	White oak	90	72	Eastern white pine, red pine, white ash, yellow-poplar, black walnut.
						Yellow-poplar	98	104	
						Sweetgum	72	61	
						Sugar maple	---	---	
						White ash	---	---	

See footnote at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
Wt-------------- Whitaker	4A	Slight	Slight	Slight	Slight	White oak-----------	70	52	Eastern white pine, white ash, red maple, yellow-poplar, American sycamore.
						Pin oak-------------	85	67	
						Yellow-poplar-------	85	81	
						Sweetgum------------	80	79	
						Northern red oak----	75	57	

* Volume is the yield in cubic feet per acre per year calculated at the age of culmination of mean annual increment for fully stocked, natural stands.

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 height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Ae: Adrian	Common ninebark, whitebelle honeysuckle.	Amur honeysuckle, Amur privet, silky dogwood, nannyberry viburnum, Tatarian honeysuckle.	Tall purple willow	Black willow, golden willow.	Imperial Carolina poplar.
BmA, BmB2: Blount	---	American cranberrybush, Tatarian honeysuckle, Amur honeysuckle, arrowwood, Amur privet, Washington hawthorn, eastern redcedar.	Osageorange, green ash, Austrian pine.	Pin oak, eastern white pine.	---
Bt. Boots					
BvB, BvC, BvD, BwA, BwB, BwC, ByC3: Boyer	Siberian peashrub	Lilac, Tatarian honeysuckle, Amur honeysuckle, autumn-olive, Washington hawthorn, radiant crabapple, eastern redcedar.	Eastern white pine, red pine, Austrian pine, jack pine.	---	---
Bz: Brookston	---	Amur honeysuckle, silky dogwood, Amur privet, American cranberrybush.	Northern white-cedar, Norway spruce, Austrian pine, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
Co: Coesse	---	Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet.	Northern white-cedar, white fir, Norway spruce, Washington hawthorn, Austrian pine, blue spruce.	Eastern white pine	Pin oak.
CsA: 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.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Fu----------------- Fulton	---	American cranberrybush, Tatarian honeysuckle, Amur honeysuckle, arrowwood, Amur privet, Washington hawthorn, eastern redcedar.	Osageorange, green ash, Austrian pine.	Pin oak, eastern white pine.	---
GsB2, GtB3--------- Glynwood	---	Amur honeysuckle, Washington hawthorn, Amur privet, arrowwood, eastern redcedar, Tatarian honeysuckle, American cranberrybush.	Austrian pine, green ash, Osageorange.	Pin oak, eastern white pine.	---
Gw----------------- Granby	---	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.
HbA---------------- Haskins	---	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.
HeG---------------- Hennepin	Siberian peashrub, Tatarian honeysuckle.	Eastern redcedar, osageorange, Russian-olive, jack pine, Washington hawthorn, silky dogwood, Amur privet, American cranberrybush.	Honeylocust, northern catalpa.	---	---
Ho----------------- Homer	---	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.
Hs. Houghton					

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Ht: 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.
KaA, KaB: Kalamazoo	---	Lilac, American cranberrybush, Siberian peashrub, silky dogwood, nannyberry viburnum, eastern redcedar.	Red pine, jack pine, green ash.	Eastern white pine, Norway spruce.	Carolina poplar.
MbB, MbC: Martinsville	---	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.
Md: Martisco	Whitebelle honeysuckle, common ninebark.	Silky dogwood, Tatarian honeysuckle, Amur honeysuckle, nannyberry viburnum, Amur privet.	Tall purple willow	Black willow, golden willow.	Imperial Carolina poplar.
Mg: Mermill	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, northern white-cedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
MmB2, MmC2, MmD2, MmE2, MoC3, MoD3: 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: Milford	---	Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet.	Washington hawthorn, white fir, blue spruce, northern white-cedar, Austrian pine, 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 height, in feet, of-- <8	8-15	16-25	26-35	>35
MvB2, MvC2, MvD2, MvE2, MxC3, MxD3, MxE3: Morley	---	Amur honeysuckle, Washington hawthorn, eastern redcedar, Amur privet, arrowwood, American cranberrybush, Tatarian honeysuckle.	Austrian pine, green ash, osageorange.	Eastern white pine, pin oak.	---
Mz: Muskego	Common ninebark, whitebelle honeysuckle.	Amur privet, silky dogwood, northern white-cedar, redosier dogwood, Tatarian honeysuckle.	Tall purple willow, white spruce.	Black willow, golden willow.	Imperial Carolina poplar.
OmB: 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	---
OsA: Oshtemo	---	Eastern redcedar, lilac, Siberian peashrub, silky dogwood, American cranberrybush, nannyberry viburnum.	Jack pine, green ash, red pine.	Eastern white pine, Norway spruce.	Imperial Carolina poplar.
Pa. Palms					
Pb: Palms	Whitebelle honeysuckle, common ninebark.	Silky dogwood, Tatarian honeysuckle, Amur privet.	Tall purple willow	Black willow, white willow, golden willow.	Carolina poplar.
Pw: Pewamo	---	Amur honeysuckle, silky dogwood, Amur privet, American cranberrybush.	Northern white-cedar, Norway spruce, Austrian pine, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
Px*. Pits					

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
RcA, RcB, RcC----- Rawson	---	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.
Re---------------- Rensselaer	---	Amur honeysuckle, silky dogwood, Amur privet, American cranberrybush.	Northern white-cedar, Norway spruce, Austrian pine, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
RhB, RhC---------- 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.	---
Sa---------------- Saranac	---	Amur honeysuckle, American cranberrybush, Amur privet, silky dogwood.	Austrian pine, white fir, northern white-cedar, Washington hawthorn, Norway spruce, blue spruce.	Eastern white pine	Pin oak.
Se---------------- Sebewa	---	Amur honeysuckle, silky dogwood, Amur privet, American cranberrybush.	Northern white-cedar, Norway spruce, Austrian pine, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
SfB, SfC---------- Seward	---	Washington hawthorn, Amur honeysuckle, Tatarian honeysuckle, Amur privet, American cranberrybush.	Eastern redcedar, northern white-cedar, Austrian pine, osageorange.	Eastern white pine, Norway spruce, red pine.	---
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.

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
So----------------- Sloan	---	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.
SpB, SpC---------- Spinks	---	Washington hawthorn, Amur privet, Amur honeysuckle, American cranberrybush, Tatarian honeysuckle.	Austrian pine, eastern redcedar, northern white-cedar, osageorange.	Eastern white pine, Norway spruce, red pine.	---
St----------------- Stonelick Variant	---	Siberian peashrub, Tatarian honeysuckle.	Osageorange, green ash, northern white-cedar, eastern redcedar, nannyberry viburnum, Washington hawthorn, white spruce.	Black willow, eastern white pine.	---
Ud*. Udorthents					
Wa, Wc------------ Wallkill	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, northern white-cedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
WmB, WmC---------- 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.
Wt----------------- Whitaker	---	Amur honeysuckle, American cranberrybush, Amur privet, silky dogwood.	White fir, Austrian pine, blue spruce, Washington hawthorn, northern white-cedar.	Norway spruce-----	Eastern white pine, pin oak.

* See description of the map unit for composition and behavior characteristics of the map unit.

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
Ae: Adrian	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
BmA, BmB2: Blount	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Bt: Boots	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
BvB: Boyer	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight	Moderate: small stones.
BvC: Boyer	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight	Moderate: small stones, slope.
BvD: Boyer	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.	Severe: slope.
BwA: Boyer	Slight	Slight	Moderate: small stones.	Slight	Slight.
BwB: Boyer	Slight	Slight	Moderate: slope.	Slight	Slight.
BwC, ByC3: Boyer	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Bz: Brookston	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Co: Coesse	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, erodes easily.	Severe: ponding.
CsA: Crosier	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Fu: Fulton	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
GsB2, GtB3: Glynwood	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Moderate: wetness.	Slight.
Gw: Granby	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
HbA: Haskins	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
HeG: Hennepin	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Ho: Homer	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Severe: erodes easily.	Moderate: wetness.
Hs, Ht: Houghton	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.
KaA: Kalamazoo	Slight	Slight	Moderate: small stones.	Slight	Moderate: droughty.
KaB: Kalamazoo	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: droughty.
MbB: Martinsville	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
MbC: Martinsville	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
Md: Martisco	Severe: ponding, flooding, excess humus.	Severe: ponding, excess humus.	Severe: flooding, excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, flooding, excess humus.
Mg: Mermill	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.
MmB2: Miami	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight	Slight.
MmC2: Miami	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.
MmD2, MmE2: Miami	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
MoC3: Miami	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
MoD3: Miami	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
Ms: Milford	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
MvB2: Morley	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight	Slight.
MvC2: Morley	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
MvD2: Morley	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
MvE2: Morley	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.
MxC3: Morley	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
MxD3: Morley	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
MxE3: Morley	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.
Mz: Muskego	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
OmB: Ormas	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: droughty.
OsA: Oshtemo	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight	Moderate: small stones.
Pa, Pb: Palms	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Pw: Pewamo	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Px*. Pits					
RcA, RcB: Rawson	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Slight	Slight.
RcC: Rawson	Severe: percs slowly.	Severe: percs slowly.	Severe: slope, percs slowly.	Slight	Moderate: slope.
Re: Rensselaer	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
RhB: Riddles	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
RhC: Riddles	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Sa: Saranac	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding, flooding.	Severe: ponding.	Severe: ponding, flooding.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Se: Sebewa	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
SfB: Seward	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Slight	Moderate: droughty.
SfC: Seward	Severe: percs slowly.	Severe: percs slowly.	Severe: slope, percs slowly.	Slight	Moderate: droughty, slope.
Sh: Shoals	Severe: flooding, wetness.	Moderate: flooding, wetness.	Severe: wetness, flooding.	Moderate: wetness, flooding.	Severe: flooding.
So: Sloan	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
SpB: Spinks	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: droughty.
SpC: Spinks	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Severe: droughty.
St: Stonelick Variant	Severe: flooding.	Slight	Moderate: small stones, flooding.	Slight	Moderate: droughty, flooding.
Ud*. Udorthents					
Wa: Wallkill	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Wc: Wallkill	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, erodes easily.	Severe: ponding.
WmB: Wawasee	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
WmC: Wawasee	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Wt: Whitaker	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

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
Ae. Adrian	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
BmA. Blount	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
BmB2. Blount	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Bt. Boots	Good	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
BvB, BvC, BvD. Boyer	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
BwA, BwB. Boyer	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
BwC, ByC3. Boyer	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Bz. Brookston	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Co. Coesse	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
CsA. Crosier	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Fu. Fulton	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
GsB2, GtB3. Glynwood	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Gw. Granby	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
HbA. Haskins	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
HeG. Hennepin	Very poor.	Poor	Good	Good	Fair	Very poor.	Very poor.	Poor	Good	Very poor.
Ho. Homer	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Hs, Ht. Houghton	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
KaA, KaB. Kalamazoo	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
MbB. Martinsville	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
MbC----------------- Martinsville	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Md------------------ Martisco	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good.
Mg------------------ Mermill	Good	Good	Good	Good	Fair	Good	Good	Good	Good	Good.
MmB2---------------- Miami	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
MmC2---------------- Miami	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
MmD2, MmE2---------- 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.
MoD3---------------- Miami	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Ms------------------ Milford	Good	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
MvB2---------------- Morley	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
MvC2---------------- Morley	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
MvD2, MvE2---------- Morley	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
MxC3---------------- Morley	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
MxD3, MxE3---------- Morley	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Mz------------------ Muskego	Good	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
OmB----------------- Ormas	Poor	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
OsA----------------- Oshtemo	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Pa, Pb-------------- Palms	Fair	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
Pw------------------ Pewamo	Good	Fair	Fair	Good	Good	Good	Good	Fair	Good	Good.
Px*. Pits										

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
RcA---------------- Rawson	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
RcB---------------- Rawson	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
RcC---------------- Rawson	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Re----------------- Rensselaer	Fair	Poor	Poor	Fair	Fair	Good	Good	Fair	Fair	Good.
RhB---------------- Riddles	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
RhC---------------- Riddles	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Sa----------------- Saranac	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Se----------------- Sebewa	Good	Fair	Fair	Good	Good	Good	Good	Fair	Good	Good.
SfB---------------- Seward	Poor	Fair	Good	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
SfC---------------- Seward	Poor	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Sh----------------- Shoals	Poor	Fair	Fair	Good	Good	Fair	Fair	Fair	Good	Fair.
So----------------- Sloan	Fair	Fair	Fair	Poor	Poor	Good	Good	Fair	Poor	Good.
SpB---------------- Spinks	Fair	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
SpC---------------- Spinks	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
St----------------- Stonelick Variant	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Ud*. Udorthents										
Wa----------------- Wallkill	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Wc----------------- Wallkill	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
WmB---------------- Wawasee	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
WmC---------------- Wawasee	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.

See footnote at end of table.

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 herba-ceous plants	Hard-wood trees	Conif-erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Wt----------------- Whitaker	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

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. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Ae: Adrian	Severe: cutbanks cave, excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: low strength, ponding, frost action.	Severe: ponding, excess humus.
BmA, BmB2: Blount	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
Bt: Boots	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: ponding, frost action, subsides.	Severe: ponding, excess humus.
BvB: Boyer	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: small stones.
BvC: Boyer	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: small stones, slope.
BvD: Boyer	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
BwA: Boyer	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Slight.
BwB: Boyer	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Slight.
BwC, ByC3: Boyer	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.
Bz: Brookston	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
Co: Coesse	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
CsA: Crosier	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, low strength.	Moderate: wetness.
Fu: Fulton	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, shrink-swell.	Moderate: wetness.
GsB2, GtB3: Glynwood	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell, slope.	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
Gw----------------- Granby	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
HbA---------------- Haskins	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
HeG---------------- Hennepin	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Ho----------------- Homer	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
Hs, Ht------------- Houghton	Severe: ponding, excess humus.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: low strength, ponding, frost action.	Severe: excess humus, ponding.
KaA, KaB----------- Kalamazoo	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: frost action, low strength.	Moderate: droughty.
MbB---------------- Martinsville	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: frost action, shrink-swell.	Slight.
MbC---------------- Martinsville	Severe: cutbanks cave.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: slope, frost action, shrink-swell.	Moderate: slope.
Md----------------- Martisco	Severe: ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding, frost action.	Severe: flooding, ponding, excess humus.
Mg----------------- Mermill	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
MmB2--------------- Miami	Moderate: dense layer.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Moderate: frost action, shrink-swell.	Slight.
MmC2--------------- Miami	Moderate: slope, dense layer.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: slope, frost action, shrink-swell.	Moderate: slope.
MmD2, MmE2--------- Miami	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
MoC3--------------- Miami	Moderate: slope, dense layer.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: slope, frost action, shrink-swell.	Moderate: slope.
MoD3--------------- Miami	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: 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
Ms----------------- Milford	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
MvB2--------------- Morley	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
MvC2--------------- Morley	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
MvD2, MvE2--------- Morley	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
MxC3--------------- Morley	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
MxD3, MxE3--------- Morley	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
Mz----------------- Muskego	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: frost action, low strength, ponding.	Severe: ponding, excess humus.
OmB---------------- Ormas	Severe: cutbanks cave.	Slight----------	Slight----------	Moderate: slope.	Moderate: frost action.	Slight.
OsA---------------- Oshtemo	Severe: cutbanks cave.	Slight----------	Slight----------	Slight----------	Slight----------	Moderate: small stones.
Pa, Pb------------- Palms	Severe: cutbanks cave, excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: ponding, frost action.	Severe: ponding, excess humus.
Pw----------------- Pewamo	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
Px*. Pits						
RcA---------------- Rawson	Moderate: wetness, too clayey, dense layer.	Slight----------	Moderate: wetness, shrink-swell.	Slight----------	Moderate: frost action.	Slight.
RcB---------------- Rawson	Moderate: wetness, too clayey, dense layer.	Slight----------	Moderate: wetness, shrink-swell.	Moderate: slope.	Moderate: frost action.	Slight.

See footnote at end of table.

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
RcC--------------- Rawson	Moderate: wetness, too clayey, dense layer.	Moderate: slope.	Moderate: wetness, slope, shrink-swell.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
Re---------------- Rensselaer	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
RhB--------------- Riddles	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Moderate: frost action, low strength.	Slight.
RhC--------------- Riddles	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: frost action, low strength, slope.	Moderate: slope.
Sa---------------- Saranac	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: low strength, ponding, flooding.	Severe: ponding, flooding.
Se---------------- Sebewa	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
SfB--------------- Seward	Severe: cutbanks cave.	Slight---------	Severe: shrink-swell.	Moderate: slope.	Moderate: frost action.	Moderate: droughty.
SfC--------------- Seward	Severe: cutbanks cave.	Moderate: slope.	Severe: shrink-swell.	Severe: slope.	Moderate: slope, frost action.	Moderate: droughty, slope.
Sh---------------- Shoals	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, frost action.	Severe: flooding.
So---------------- Sloan	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness, flooding.
SpB--------------- Spinks	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Severe: droughty.
SpC--------------- Spinks	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
St---------------- Stonelick Variant	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: droughty, flooding.
Ud*. Udorthents						
Wa---------------- Wallkill	Severe: ponding, excess humus.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.

See footnote at end of table.

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
Wc----------------- Wallkill	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, frost action.	Severe: ponding.
WmB---------------- Wawasee	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Slight.
WmC---------------- Wawasee	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
Wt----------------- Whitaker	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ae: Adrian	Severe: ponding, poor filter.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
BmA, BmB2: Blount	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Bt: Boots	Severe: subsides, ponding.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
BvB: Boyer	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
BvC: Boyer	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
BvD: Boyer	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
BwA, BwB: Boyer	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
BwC, ByC3: Boyer	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Bz: Brookston	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
Co: Coesse	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
CsA: Crosier	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Fu: Fulton	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.

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
GsB2, GtB3: Glynwood	Severe: wetness, percs slowly.	Moderate: slope.	Moderate: wetness, too clayey.	Moderate: wetness.	Fair: too clayey, wetness.
Gw: Granby	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
HbA: Haskins	Severe: wetness, percs slowly.	Moderate: seepage.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
HeG: Hennepin	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Ho: Homer	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
Hs, Ht: Houghton	Severe: ponding, percs slowly.	Severe: seepage, ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, seepage.	Poor: ponding, excess humus.
KaA, KaB: Kalamazoo	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: thin layer.
MbB: Martinsville	Slight	Severe: seepage.	Severe: seepage.	Slight	Fair: thin layer.
MbC: Martinsville	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Moderate: slope.	Fair: slope, thin layer.
Md: Martisco	Severe: flooding, ponding, percs slowly.	Severe: flooding, seepage, excess humus.	Severe: flooding, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding.
Mg: Mermill	Severe: ponding, percs slowly.	Moderate: seepage.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
MmB2: Miami	Severe: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
MmC2: Miami	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
MmD2, MmE2: Miami	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
MoC3: Miami	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.

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
MoD3: Miami	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Ms: Milford	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
MvB2: Morley	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
MvC2: Morley	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
MvD2, MvE2: Morley	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
MxC3: Morley	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
MxD3, MxE3: Morley	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Mz: Muskego	Severe: ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: seepage, ponding.	Poor: hard to pack, ponding.
OmB: Ormas	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: thin layer.
OsA: Oshtemo	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: seepage.
Pa, Pb: Palms	Severe: ponding.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
Pw: Pewamo	Severe: percs slowly, ponding.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, ponding, hard to pack.
Px*. Pits					
RcA: Rawson	Severe: wetness, percs slowly.	Moderate: seepage.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
RcB: Rawson	Severe: wetness, percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.

See footnote at end of table.

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
RcC----------------- Rawson	Severe: wetness, percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: wetness, slope.	Poor: too clayey, hard to pack.
Re------------------ Rensselaer	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
RhB----------------- Riddles	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
RhC----------------- Riddles	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: slope, too clayey.
Sa------------------ Saranac	Severe: flooding, ponding, percs slowly.	Severe: seepage, flooding, ponding.	Severe: flooding, seepage, ponding.	Severe: flooding, ponding.	Poor: too clayey, ponding.
Se------------------ Sebewa	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, small stones.
SfB----------------- Seward	Severe: wetness, percs slowly.	Severe: seepage.	Severe: too clayey.	Severe: seepage.	Poor: too clayey, hard to pack.
SfC----------------- Seward	Severe: wetness, percs slowly.	Severe: seepage, slope.	Severe: too clayey.	Severe: seepage.	Poor: too clayey, hard to pack.
Sh------------------ Shoals	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: wetness.
So------------------ Sloan	Severe: flooding, wetness, percs slowly.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Poor: wetness.
SpB----------------- Spinks	Slight-----------	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
SpC----------------- Spinks	Moderate: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
St------------------ Stonelick Variant	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Fair: too sandy, thin layer.
Ud*. Udorthents					

See footnote at end of table.

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
Wa------------------ Wallkill	Severe: ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Poor: ponding.
Wc------------------ Wallkill	Severe: ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus, seepage.	Severe: seepage, ponding.	Poor: ponding, excess humus.
WmB----------------- Wawasee	Moderate: percs slowly.	Moderate: seepage, slope.	Slight-----------	Slight-----------	Good.
WmC----------------- Wawasee	Moderate: slope, percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Wt------------------ Whitaker	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: wetness.	Poor: wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ae-------------------- Adrian	Poor: wetness.	Probable-------------	Improbable: too sandy.	Poor: excess humus, wetness.
BmA, BmB2------------- Blount	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Bt-------------------- Boots	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
BvB, BvC-------------- Boyer	Good------------------	Probable-------------	Probable-------------	Poor: small stones, area reclaim.
BvD------------------- Boyer	Fair: slope.	Probable-------------	Probable-------------	Poor: small stones, area reclaim, slope.
BwA, BwB, BwC, ByC3--- Boyer	Good------------------	Probable-------------	Probable-------------	Poor: small stones, area reclaim.
Bz-------------------- Brookston	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Co-------------------- Coesse	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
CsA------------------- Crosier	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Fu-------------------- Fulton	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
GsB2, GtB3------------ Glynwood	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Gw-------------------- Granby	Poor: wetness.	Probable-------------	Improbable: too sandy.	Poor: wetness.
HbA------------------- Haskins	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, thin layer.
HeG------------------- Hennepin	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Ho-------------------- Homer	Fair: wetness.	Probable-------------	Probable-------------	Poor: small stones, area reclaim.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Hs, Ht: Houghton	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: wetness, excess humus.
KaA, KaB: Kalamazoo	Good	Probable	Probable	Poor: small stones, area reclaim.
MbB: Martinsville	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
MbC: Martinsville	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
Md: Martisco	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
Mg: Mermill	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
MmB2: Miami	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
MmC2: Miami	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, slope.
MmD2, MmE2: Miami	Fair: slope, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
MoC3: Miami	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, slope.
MoD3: Miami	Fair: slope, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Ms: Milford	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
MvB2, MvC2: Morley	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
MvD2: Morley	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
MvE2: Morley	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
MxC3: Morley	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
MxD3: Morley	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
MxE3: Morley	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
Mz: Muskego	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
OmB: Ormas	Good	Probable	Probable	Fair: too sandy, small stones.
OsA: Oshtemo	Good	Probable	Probable	Poor: small stones.
Pa, Pb: Palms	Poor: wetness.	Probable	Probable	Poor: excess humus, wetness.
Pw: Pewamo	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Px*. Pits				
RcA, RcB: Rawson	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, thin layer.
RcC: Rawson	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, thin layer, slope.
Re: Rensselaer	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
RhB: Riddles	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
RhC: Riddles	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, small stones.
Sa: Saranac	Poor: wetness.	Probable	Probable	Poor: thin layer, wetness.
Se: Sebewa	Poor: wetness.	Probable	Probable	Poor: small stones, area reclaim, wetness.
SfB: Seward	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
SfC------------------- Seward	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, too sandy.
Sh-------------------- Shoals	Fair: wetness.	Probable-------------	Improbable: too sandy.	Fair: area reclaim.
So-------------------- Sloan	Poor: wetness.	Probable-------------	Probable-------------	Poor: area reclaim, wetness.
SpB, SpC-------------- Spinks	Good-----------------	Probable-------------	Improbable: too sandy.	Poor: too sandy.
St-------------------- Stonelick Variant	Good-----------------	Probable-------------	Improbable: too sandy.	Fair: small stones.
Ud*. Udorthents				
Wa-------------------- Wallkill	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Wc-------------------- Wallkill	Poor: thin layer, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
WmB------------------- Wawasee	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
WmC------------------- Wawasee	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
Wt-------------------- Whitaker	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

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. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

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
Ae----------------- Adrian	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, subsides, frost action.	Ponding, too sandy, soil blowing.	Wetness.
BmA---------------- Blount	Slight---------	Moderate: piping, wetness.	Severe: no water.	Percs slowly, frost action.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily.
BmB2--------------- Blount	Moderate: slope.	Moderate: piping, wetness.	Severe: no water.	Percs slowly, frost action, slope.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily.
Bt----------------- Boots	Severe: seepage.	Severe: excess humus, ponding.	Moderate: slow refill.	Ponding, subsides, frost action.	Ponding, soil blowing.	Wetness.
BvB---------------- Boyer	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Too sandy------	Droughty.
BvC, BvD----------- Boyer	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, too sandy.	Slope, droughty.
BwA, BwB----------- Boyer	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Too sandy------	Droughty.
BwC---------------- Boyer	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, too sandy.	Slope, droughty.
ByC3--------------- Boyer	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, too sandy.	Slope.
Bz----------------- Brookston	Moderate: seepage.	Severe: ponding.	Moderate: slow refill.	Ponding, frost action.	Ponding---------	Wetness.
Co----------------- Coesse	Slight---------	Severe: ponding.	Severe: slow refill.	Ponding, frost action.	Erodes easily, ponding.	Wetness, rooting depth, erodes easily.
CsA---------------- Crosier	Slight---------	Severe: piping, wetness.	Severe: slow refill.	Frost action---	Wetness, soil blowing.	Wetness.
Fu----------------- Fulton	Slight---------	Moderate: wetness, hard to pack.	Severe: no water.	Percs slowly---	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
GsB2, GtB3--------- Glynwood	Moderate: slope.	Moderate: piping, wetness.	Severe: no water.	Percs slowly, frost action, slope.	Erodes easily, wetness.	Erodes easily, rooting depth.

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
Gw----------------- Granby	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Ponding, too sandy, soil blowing.	Wetness, droughty.
HbA---------------- Haskins	Moderate: seepage.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, frost action.	Erodes easily, wetness.	Wetness, erodes easily, rooting depth.
HeG---------------- Hennepin	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, percs slowly.	Slope, droughty, percs slowly.
Ho----------------- Homer	Severe: seepage.	Severe: seepage, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Erodes easily, wetness.	Wetness, erodes easily.
Hs, Ht------------- Houghton	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Frost action, subsides, ponding.	Ponding, soil blowing.	Wetness.
KaA, KaB----------- Kalamazoo	Severe: seepage.	Severe: thin layer.	Severe: no water.	Deep to water	Soil blowing---	Droughty.
MbB---------------- Martinsville	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
MbC---------------- Martinsville	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
Md----------------- Martisco	Moderate: seepage.	Severe: ponding.	Severe: slow refill.	Ponding, flooding, percs slowly.	Ponding, soil blowing, percs slowly.	Wetness, percs slowly.
Mg----------------- Mermill	Moderate: seepage.	Severe: ponding.	Severe: no water.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Wetness, rooting depth, percs slowly.
MmB2--------------- Miami	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Erodes easily, soil blowing.	Erodes easily, rooting depth.
MmC2, MmD2, MmE2-- Miami	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, erodes easily, soil blowing.	Slope, erodes easily, rooting depth.
MoC3, MoD3--------- Miami	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily, rooting depth.
Ms----------------- Milford	Slight---------	Severe: ponding.	Severe: slow refill.	Ponding, frost action.	Erodes easily, ponding.	Wetness, erodes easily.
MvB2--------------- Morley	Moderate: slope.	Slight---------	Severe: no water.	Deep to water	Erodes easily, percs slowly.	Erodes easily, percs slowly.
MvC2, MvD2, MvE2, MxC3, MxD3, MxE3- Morley	Severe: slope.	Slight---------	Severe: no water.	Deep to water	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.

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
Mz: Muskego	Slight	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, percs slowly, subsides.	Ponding, soil blowing, percs slowly.	Wetness, percs slowly.
OmB: Ormas	Severe: seepage.	Severe: thin layer.	Severe: no water.	Deep to water	Soil blowing	Droughty.
OsA: Oshtemo	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Too sandy, soil blowing.	Favorable.
Pa, Pb: Palms	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill, cutbanks cave.	Ponding, subsides, frost action.	Ponding, soil blowing.	Wetness.
Pw: Pewamo	Slight	Severe: ponding.	Severe: slow refill.	Ponding, frost action.	Ponding	Wetness.
Px*. Pits						
RcA: Rawson	Moderate: seepage.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly	Wetness, soil blowing.	Percs slowly.
RcB: Rawson	Moderate: seepage, slope.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, slope.	Wetness, soil blowing.	Percs slowly.
RcC: Rawson	Severe: slope.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, slope.	Slope, wetness, soil blowing.	Slope, percs slowly.
Re: Rensselaer	Moderate: seepage.	Severe: thin layer, ponding.	Severe: cutbanks cave.	Ponding, frost action.	Ponding	Wetness.
RhB: Riddles	Moderate: seepage, slope.	Slight	Severe: no water.	Deep to water	Soil blowing	Favorable.
RhC: Riddles	Severe: slope.	Slight	Severe: no water.	Deep to water	Slope, soil blowing.	Slope.
Sa: Saranac	Severe: seepage.	Severe: ponding.	Severe: slow refill, cutbanks cave.	Ponding, flooding, frost action.	Erodes easily, ponding.	Wetness, erodes easily.
Se: Sebewa	Severe: seepage.	Severe: seepage, ponding.	Severe: cutbanks cave.	Ponding, frost action, cutbanks cave.	Ponding, too sandy.	Wetness.
SfB: Seward	Severe: seepage.	Moderate: hard to pack.	Severe: no water.	Deep to water	Percs slowly, soil blowing.	Droughty, rooting depth.
SfC: Seward	Severe: seepage, slope.	Moderate: hard to pack.	Severe: no water.	Deep to water	Slope, percs slowly, soil blowing.	Slope, droughty, rooting depth.

See footnote at end of table.

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
Sh------------------ Shoals	Severe: seepage.	Severe: piping, wetness.	Severe: cutbanks cave.	Flooding, frost action.	Erodes easily, wetness.	Wetness, erodes easily.
So------------------ Sloan	Severe: seepage.	Severe: thin layer, wetness.	Severe: slow refill, cutbanks cave.	Flooding, frost action.	Erodes easily, wetness.	Wetness, erodes easily.
SpB----------------- Spinks	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Too sandy, soil blowing.	Droughty.
SpC----------------- Spinks	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, too sandy, soil blowing.	Slope, droughty.
St------------------ Stonelick Variant	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Soil blowing---	Droughty.
Ud*. Udorthents						
Wa------------------ Wallkill	Severe: seepage.	Severe: ponding, excess humus.	Severe: slow refill.	Ponding, frost action.	Ponding--------	Wetness.
Wc------------------ Wallkill	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, subsides.	Erodes easily, ponding.	Wetness, erodes easily, percs slowly.
WmB----------------- Wawasee	Moderate: seepage, slope.	Moderate: thin layer, piping.	Severe: no water.	Deep to water	Soil blowing---	Favorable.
WmC----------------- Wawasee	Severe: slope.	Moderate: thin layer, piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Slope.
Wt------------------ Whitaker	Moderate: seepage.	Severe: wetness, piping.	Moderate: slow refill, cutbanks cave.	Frost action---	Erodes easily, wetness.	Wetness, erodes easily.

* See description of the map unit for composition and behavior characteristics of the map unit.

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		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Ae----------------- Adrian	0-21	Sapric material	PT	A-8	---	---	---	---	---	---	---
	21-60	Sand, loamy fine sand, gravelly loamy sand.	SP, SM	A-2, A-3, A-1	0	80-100	60-100	35-75	0-30	---	NP
BmA, BmB2--------- Blount	0-10	Silt loam---------	CL	A-6, A-4	0-5	95-100	95-100	90-100	80-95	25-40	8-20
	10-25	Silty clay loam, clay, clay loam.	CH, CL	A-7, A-6	0-5	95-100	90-100	80-90	75-85	35-60	15-35
	25-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	90-100	90-100	80-100	70-90	30-45	10-25
Bt----------------- Boots	0-15	Sapric material	PT	A-8	0	---	---	---	---	---	---
	15-60	Hemic material---	PT	A-8	0	---	---	---	---	---	---
BvB, BvC, BvD----- Boyer	0-8	Loamy sand--------	SM, SM-SC	A-2, A-1	0-5	95-100	65-95	45-75	15-30	<20	NP-6
	8-25	Sandy loam, loam, gravelly sandy loam.	SM, SC, SM-SC, SP-SM	A-2, A-4, A-6	0-5	80-100	65-95	55-85	10-45	10-35	NP-16
	25-60	Gravelly sand, coarse sand, gravel.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2-4	0-10	40-100	35-100	30-70	0-10	---	NP
BwA, BwB, BwC----- Boyer	0-10	Sandy loam--------	SM, SM-SC, ML, CL-ML	A-2, A-4	0-5	95-100	75-95	50-90	25-65	<25	NP-7
	10-32	Sandy loam, loam, gravelly sandy loam.	SM, SC, SM-SC, SP-SM	A-2, A-4, A-6	0-5	80-100	65-95	55-85	10-45	10-35	NP-16
	32-60	Gravelly coarse sand, sand, gravel.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2-4	0-10	40-100	35-100	30-70	0-10	---	NP
ByC3-------------- Boyer	0-8	Loam--------------	SM, CL, ML, SC	A-4	0-5	95-100	75-95	60-75	45-60	<25	NP-10
	8-25	Sandy loam, loam, gravelly sandy loam.	SM, SC, SM-SC, SP-SM	A-2, A-4, A-6	0-5	80-100	65-95	55-85	10-45	10-35	NP-16
	25-60	Gravelly sand, coarse sand, gravel.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2-4	0-10	40-100	35-100	30-70	0-10	---	NP
Bz----------------- Brookston	0-17	Loam--------------	CL, CL-ML	A-4, A-6	0	95-100	95-100	85-100	60-90	20-30	5-15
	17-53	Clay loam, silty clay loam, loam.	CL	A-6, A-4	0	98-100	85-100	75-95	60-85	25-40	8-20
	53-60	Loam--------------	CL, CL-ML	A-4, A-6	0-3	90-100	85-95	78-90	55-70	20-30	5-15
Co----------------- Coesse	0-8	Silty clay loam	CL	A-6	0	100	95-100	90-100	70-95	30-40	10-15
	8-22	Silty clay loam	CL	A-6	0	100	95-100	90-100	70-95	30-40	10-15
	22-34	Clay, silty clay	CL, CH	A-7	0	100	95-100	90-100	70-95	45-60	20-30
	34-55	Clay, silty clay	CL, CH	A-7	0-3	95-100	90-100	85-100	70-95	45-60	20-30
	55-80	Silty clay loam, clay loam.	CL	A-6, A-7	0-3	95-100	90-100	85-100	70-95	30-45	10-20
CsA--------------- Crosier	0-8	Sandy loam--------	SM, SC, SM-SC	A-2, A-4	0	100	95-100	60-70	30-40	20-30	3-10
	8-25	Clay loam, loam, sandy clay loam.	CL	A-6, A-7	0	90-95	85-95	75-90	60-70	33-47	15-26
	25-60	Loam, sandy loam	CL, ML	A-4, A-6	0-3	85-90	80-90	70-85	50-60	25-35	2-12

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	
Fu----------------- Fulton	0-10	Silty clay loam	CL	A-6, A-7	0	95-100	95-100	85-100	80-95	35-50	12-24
	10-25	Silty clay, clay	CH, CL	A-7	0	100	100	90-100	85-100	40-60	18-34
	25-60	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	100	100	90-100	85-100	40-60	18-34
GsB2-------------- Glynwood	0-8	Loam--------------	CL-ML, CL	A-4, A-6	0	95-100	90-100	80-100	55-90	23-40	4-15
	8-22	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
	22-60	Clay loam, silty clay loam.	CL	A-6, A-4	0-5	95-100	80-100	75-95	65-90	25-40	7-18
GtB3-------------- Glynwood	0-9	Clay loam---------	CL	A-6, A-7	0-2	95-100	85-100	75-100	60-95	25-45	10-22
	9-21	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
	21-60	Clay loam, silty clay loam.	CL	A-6, A-4	0-5	95-100	80-100	75-95	65-90	25-40	7-18
Gw----------------- Granby	0-11	Loamy sand--------	SM	A-2	0	100	100	50-75	15-30	---	NP
	11-32	Sand, fine sand, loamy sand.	SP, SP-SM, SM	A-3, A-2	0	100	90-100	50-75	0-20	---	NP
	32-60	Sand, fine sand, gravelly sand.	SP, SP-SM	A-3, A-2	0	100	75-100	50-70	0-5	---	NP
HbA--------------- Haskins	0-11	Loam--------------	CL-ML, CL	A-4, A-6	0	95-100	85-100	70-100	55-90	25-40	5-20
	11-27	Clay loam, gravelly sandy clay loam, loam.	SC, CL	A-6, A-4, A-2	0	85-100	70-100	55-85	30-65	20-40	7-20
	27-60	Clay, silty clay loam, clay loam.	CH, CL	A-7, A-6	0	100	85-100	80-100	70-95	35-65	15-40
HeG--------------- Hennepin	0-3	Loam--------------	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	70-100	60-95	25-40	5-20
	3-18	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
	18-60	Loam, clay loam, sandy 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
Ho----------------- Homer	0-8	Loam--------------	CL, CL-ML, ML	A-4, A-6	0	95-100	85-100	85-100	70-95	<25	3-8
	8-14	Sandy clay loam, clay loam, loam.	ML, CL	A-6, A-7, A-4	0	90-100	87-100	90-100	70-95	30-50	8-20
	14-36	Gravelly sandy clay loam, sandy clay loam, sandy loam.	SC	A-2-6, A-6, A-4	0-3	90-100	60-75	45-60	30-50	25-30	8-11
	36-60	Stratified gravelly loamy coarse sand to very gravelly sand.	SP, GP, SP-SM, GP-GM	A-1	1-5	30-70	25-55	7-20	2-10	<20	NP
Hs, Ht------------ Houghton	0-60	Sapric material	PT	A-8	0	---	---	---	---	---	---

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
KaA, KaB---------- Kalamazoo	0-9	Sandy loam--------	SM, SM-SC,	A-2-4,	0-5	95-100	80-100	60-70	15-35	<20	NP-7
	9-34	Sandy loam, sandy clay loam, gravelly sandy clay loam.	SC, CL	A-4, A-6,	0-5	95-100	70-95	65-95	35-80	20-38	9-20
	34-47	Gravelly sandy loam, loamy sand, gravelly loamy coarse sand.	SM, SP-SM,	A-2-4, A-1-b	0-5	95-100	60-95	40-60	10-25	---	NP
	47-60	Sand, gravelly coarse sand.	SP, SP-SM,	A-1, A-3, A-2	0-5	60-80	25-75	10-55	0-10	---	NP
MbB, MbC---------- Martinsville	0-10	Loam--------------	CL, CL-ML, ML	A-4	0	100	85-100	75-100	65-90	<25	3-8
	10-36	Clay loam, loam, sandy clay loam.	CL, SC	A-4, A-6, A-2	0	95-100	85-100	70-100	30-95	25-40	7-15
	36-50	Sandy loam, loam, sandy clay loam.	SM-SC, CL-ML, CL, SC	A-2, A-4, A-6	0	95-100	85-100	55-95	30-75	20-30	5-11
	50-60	Stratified sand to silt loam.	SM, SM-SC, CL-ML	A-4, A-2-4, A-1	0	95-100	85-100	45-95	10-75	<25	NP-8
Md---------------- Martisco	0-12	Sapric material	PT	A-8	0	---	---	---	---	---	---
	12-60	Marl--------------	---	---	0	---	---	---	---	---	---
Mg---------------- Mermill	0-9	Loam--------------	ML, SM, CL, SC	A-4	0	95-100	90-100	75-95	40-75	20-35	3-10
	9-39	Clay loam, sandy clay loam, loam.	SC, CL	A-6, A-7, A-4	0	90-100	80-100	70-85	40-75	24-44	8-22
	39-60	Clay, silty clay, clay loam.	CH, CL	A-7, A-6	0-2	100	90-100	90-100	80-95	38-65	18-40
MmB2, MmC2, MmD2, MmE2------------ Miami	0-8	Sandy loam--------	SM, SC, SM-SC	A-4, A-2-4	0	100	95-100	60-85	30-50	<25	3-10
	8-30	Clay loam, silty clay loam, loam.	CL, SC	A-6	0	90-100	85-100	70-95	40-95	30-40	15-25
	30-60	Loam--------------	CL, SC, ML	A-4, A-6	0-3	85-100	85-100	70-90	45-70	25-35	8-15
MoC3, MoD3-------- Miami	0-7	Clay loam---------	CL	A-6	0	100	90-100	75-95	65-95	30-40	15-20
	7-24	Clay loam, silty clay loam.	CL, SC	A-6	0	90-100	85-100	70-95	40-95	30-40	15-25
	24-60	Loam--------------	CL, SC, ML	A-4, A-6	0-3	85-100	85-100	70-90	45-70	25-35	8-15
Ms---------------- Milford	0-8	Silty clay loam	CL, CH	A-7	0	100	95-100	90-100	75-95	40-60	20-35
	8-42	Silty clay, silty clay loam, clay.	CH, CL	A-7	0	100	95-100	90-100	75-100	40-60	20-40
	42-60	Stratified clay to sandy loam.	CL, SC	A-6, A-7	0	97-100	95-100	90-100	45-100	25-50	10-30
MvB2, MvC2, MvD2, MvE2------------- Morley	0-10	Loam--------------	CL, CL-ML	A-6, A-4	0-5	95-100	95-100	90-100	75-95	25-40	5-15
	10-24	Silty clay, clay loam, clay.	CL, CH	A-7	0-10	95-100	90-100	85-95	80-90	40-60	15-35
	24-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-50	15-30

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
MxC3, MxD3, MxE3- Morley	0-9	Clay loam	CL	A-6, A-7	0-5	95-100	90-100	85-95	80-90	30-45	15-25
	9-22	Silty clay, clay loam, clay.	CL, CH	A-7	0-10	95-100	90-100	85-95	80-90	40-60	15-35
	22-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-50	15-30
Mz Muskego	0-18	Sapric material	PT	A-8	0	---	---	---	---	---	---
	18-52	Coprogenous earth	OL	A-5	0	100	100	95-100	80-96	40-50	2-8
	52-60	Clay loam, silty clay loam.	CL	A-6	0-3	95-100	90-100	80-100	60-95	30-40	10-15
OmB Ormas	0-21	Loamy fine sand	SM	A-2-4	0	98-100	95-100	50-75	15-30	---	NP
	21-25	Sandy loam, fine sandy loam.	SM-SC, SM	A-2-4, A-4	0	90-100	85-100	50-70	25-40	<15	NP-5
	25-48	Gravelly sandy clay loam, gravelly coarse 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
	48-60	Gravelly sand, sand, gravelly coarse sand.	SP, SP-SM,	A-3, A-1-b, A-2-4	0	60-80	55-80	30-55	3-12	---	NP
OsA Oshtemo	0-10	Sandy loam	SM, SM-SC,	A-2, A-4	0	95-100	60-95	60-70	25-40	15-25	2-7
	10-45	Sandy loam, gravelly sandy clay loam, gravelly sandy loam.	SM, SC, SM-SC	A-2, A-4, A-6	0	95-100	60-95	60-85	25-45	12-30	2-16
	45-60	Stratified loamy sand to gravel.	SP-SM, GP, SP, GP-GM	A-1, A-2, A-3	0-5	40-90	35-85	20-60	0-10	---	NP
Pa, Pb Palms	0-23	Sapric material	PT	A-8	0	---	---	---	---	---	---
	23-51	Clay loam, silt loam, silty clay loam.	CL-ML, CL	A-4, A-6	0	100	100	95-100	65-80	20-35	5-15
	51-60	Fine sand, loamy fine sand, gravelly coarse sand.	SM, SP-SM, SP, GP	A-2, A-4, A-3, A-1	0-5	60-100	40-100	20-100	2-40	---	NP
Pw Pewamo	0-11	Silty clay loam	CL	A-6, A-7	0-5	90-100	80-100	80-100	70-90	35-50	15-25
	11-47	Clay loam, clay, silty clay loam.	CL, CH	A-7, A-6	0-5	95-100	90-100	90-100	75-95	35-55	15-30
	47-60	Clay loam, silty clay loam.	CL	A-7	0-5	95-100	90-100	90-100	70-90	40-50	15-25
Px*. Pits											
RcA, RcB, RcC Rawson	0-9	Sandy loam	SM, ML	A-2-4, A-4	0	90-100	80-100	50-85	25-55	<30	NP-5
	9-31	Sandy loam, sandy clay loam, gravelly sandy clay loam.	SC, CL,	A-4, A-6, A-2-4, A-2-6	0	65-100	55-95	45-90	25-75	20-40	7-20
	31-60	Clay, silty clay loam, clay loam.	CH, CL	A-7, A-6	0	90-100	85-100	85-100	75-95	35-65	15-40

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Re---------------- Rensselaer	0-14	Loam-------------	CL, ML, CL-ML	A-4, A-6	0	95-100	90-100	80-100	55-90	15-35	4-15
	14-34	Clay loam, sandy clay loam, loam.	CL	A-6, A-4	0	95-100	90-100	80-100	50-95	25-40	8-20
	34-48	Sandy clay loam, sandy loam, loamy sand.	CL, SC	A-6, A-4, A-2-4, A-2-6	0	95-100	90-100	55-100	25-65	25-35	8-15
	48-60	Stratified fine sand to silt loam.	CL, SC, ML, SM	A-4, A-2	0	95-100	90-100	45-95	25-85	<25	2-10
RhB, RhC--------- Riddles	0-13	Sandy loam-------	SM, SC, SM-SC	A-2-4, A-4	0	95-100	85-95	50-70	25-40	20-30	2-10
	13-48	Sandy clay loam, clay loam, loam.	CL, SC	A-6	0	90-100	80-95	75-90	35-75	25-40	10-20
	48-60	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
Sa---------------- Saranac	0-11	Silty clay loam	CL	A-6	0	100	100	90-100	70-95	30-40	10-15
	11-46	Silty clay loam, silty clay, clay.	CL	A-6, A-7	0	100	100	90-100	70-95	30-45	10-20
	46-60	Stratified gravelly coarse sand to silt loam.	GP, GM, SP, SM, ML	A-4, A-1, A-2, A-3	0	45-85	45-80	20-70	2-50	---	NP
Se---------------- Sebewa	0-13	Loam-------------	CL, CL-ML, ML	A-4, A-6	0	95-100	80-100	75-95	50-90	15-30	3-15
	13-33	Sandy clay loam, clay loam, gravelly sandy loam.	SC, CL	A-4, A-6	0	95-100	65-95	55-85	40-75	25-40	8-20
	33-60	Gravelly coarse sand, sand.	SP, SP-SM, GP, GP-GM	A-1	0-5	40-75	35-70	20-40	0-10	---	NP
SfB, SfC--------- Seward	0-10	Loamy fine sand	SM, ML	A-2, A-4, A-1	0	100	95-100	45-80	15-55	---	NP
	10-30	Sand, fine sand, loamy sand.	SM, ML	A-2, A-4, A-1	0	100	95-100	45-80	15-55	---	NP
	30-35	Sandy clay loam, sandy loam.	SM	A-4	0	100	90-100	60-80	35-50	<40	NP-10
	35-60	Clay, silty clay loam, clay loam.	CH, CL	A-7	0	100	90-100	85-100	75-95	40-65	20-38
Sh---------------- Shoals	0-14	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	85-100	60-90	22-36	6-15
	14-23	Loam-------------	CL-ML, CL	A-4, A-6	0	100	100	85-100	60-80	26-40	6-15
	23-48	Sandy loam, loam	SM-SC, SC, SM	A-2-4, A-4	0	100	100	60-70	25-40	20-30	NP-10
	48-60	Loamy sand, sand, gravelly coarse sand.	SW-SM, SM, SP-SM	A-2, A-3, A-1	0	80-100	70-100	35-75	5-25	---	NP
So---------------- Sloan	0-18	Loam-------------	CL, CL-ML	A-4, A-6	0	90-100	85-95	75-95	55-85	20-35	5-15
	18-33	Loam, silt loam, clay loam.	CL	A-6, A-7	0	85-95	80-95	65-95	50-85	30-50	10-30
	33-54	Stratified sandy loam to silty clay loam.	CL-ML, CL, SC, SM-SC	A-4, A-6, A-7	0	85-95	80-95	45-95	35-85	25-45	5-20
	54-60	Loamy fine sand to gravelly coarse sand.	SP, SP-SM,	A-1, A-3, A-2	0-5	55-90	50-90	20-60	3-10	---	NP

See footnote at end of table.

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	
SpB, SpC--------- Spinks	0-11	Sand-------------	SP-SM, SM	A-2-4, A-3	0	100	80-100	50-90	5-20	---	NP
	11-25	Loamy sand, sand	SM, SP-SM,	A-2-4, A-3	0	100	80-100	50-90	5-25	---	NP
	25-74	Stratified sand to loamy fine sand.	SM, SP-SM	A-2-4	0	100	80-100	60-90	10-30	---	NP
	74-80	Fine sand, sand	SP-SM, SM	A-2-4, A-3	0	100	80-100	50-90	5-25	---	NP
St--------------- Stonelick Variant	0-10	Sandy loam-------	SM, SM-SC	A-4, A-2	0	90-100	85-100	50-80	20-50	<20	NP-5
	10-55	Sandy loam, fine sandy loam, loamy fine sand.	SM, SM-SC	A-2, A-4, A-1	0	90-100	85-100	45-70	15-50	<20	NP-5
	55-60	Loamy fine sand, sand.	SM, SP, SW	A-2, A-3, A-1	0-2	95-100	85-100	40-60	2-25	---	NP
Ud*. Udorthents											
Wa--------------- Wallkill	0-8	Silty clay loam	ML, CL-ML, CL	A-4, A-6	0	95-100	90-100	85-100	70-95	16-32	3-12
	8-21	Silt loam, silty clay loam.	CL-ML, CL	A-4, A-6	0	90-100	85-100	75-100	60-85	20-34	6-13
	21-60	Sapric material, hemic material.	PT, OH	A-8	0	---	---	---	---	---	---
Wc--------------- Wallkill	0-9	Silty clay loam	CL	A-6, A-7	0	100	95-100	90-100	70-95	30-45	10-20
	9-22	Silty clay loam	CL	A-6, A-7	0	100	95-100	90-100	70-95	30-45	10-20
	22-41	Sapric material	PT	A-8	0	---	---	---	---	---	---
	41-60	Coprogenous earth	CL, CH	A-6, A-7	0	100	100	95-100	80-100	30-60	15-30
WmB, WmC--------- Wawasee	0-9	Sandy loam-------	SM, SM-SC	A-2-4, A-4	0	90-100	85-95	80-95	30-50	<25	NP-6
	9-31	Loam, sandy clay loam, clay loam.	CL, SC	A-4, A-6	0	90-100	85-95	80-95	45-70	25-35	7-15
	31-60	Loam, sandy loam, fine sandy loam.	SM-SC, SC, CL-ML, CL	A-4, A-6, A-2	0	90-100	80-95	50-90	25-66	20-30	4-12
Wt--------------- Whitaker	0-14	Loam-------------	CL, CL-ML, ML	A-4, A-6	0	100	95-100	80-100	60-90	15-35	2-15
	14-51	Clay loam, silty clay loam, sandy clay loam.	CL, CL-ML	A-6, A-4	0	100	95-100	90-100	70-80	20-35	5-15
	51-60	Stratified coarse sand to silt loam.	ML, SM, CL-ML, SM-SC	A-4	0	98-100	98-100	60-85	40-60	<25	NP-7

* See description of the map unit for composition and behavior characteristics of the map unit.

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	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/cc	In/hr	In/in	pH					Pct
Ae-----------------	0-21	---	0.30-0.55	0.2-6.0	0.35-0.45	5.6-7.3	-------------	----	2	2	55-75
Adrian	21-60	2-10	1.40-1.75	6.0-20	0.03-0.08	6.1-8.4	Low----------	----			
BmA, BmB2---------	0-10	22-27	1.35-1.55	0.6-2.0	0.20-0.24	5.6-7.3	Low----------	0.43	3	6	1-3
Blount	10-25	35-50	1.40-1.70	0.06-0.6	0.12-0.19	5.6-7.8	Moderate-----	0.43			
	25-60	27-38	1.60-1.85	0.06-0.2	0.07-0.10	7.4-8.4	Moderate-----	0.43			
Bt-----------------	0-15	---	0.16-0.45	0.6-6.0	0.35-0.45	5.6-7.3	-------------	----	2	2	>50
Boots	15-60	---	0.16-0.28	0.6-6.0	0.35-0.45	5.6-7.3	-------------	----			
BvB, BvC, BvD-----	0-8	0-10	1.15-1.60	6.0-20	0.08-0.10	5.6-6.5	Low----------	0.17	4	2	.5-3
Boyer	8-25	10-18	1.25-1.60	2.0-6.0	0.11-0.13	5.6-7.8	Low----------	0.24			
	25-60	0-10	1.20-1.45	>20	0.02-0.04	7.4-8.4	Low----------	0.10			
BwA, BwB, BwC-----	0-10	5-15	1.15-1.60	2.0-6.0	0.11-0.13	5.6-6.5	Low----------	0.24	4	3	.5-3
Boyer	10-32	10-18	1.25-1.60	2.0-6.0	0.11-0.13	5.6-7.8	Low----------	0.24			
	32-60	0-10	1.20-1.45	>20	0.02-0.04	7.4-8.4	Low----------	0.10			
ByC3---------------	0-8	0-10	1.15-1.60	6.0-20	0.08-0.10	5.6-6.5	Low----------	0.17	3	2	.5-3
Boyer	8-25	10-18	1.25-1.60	2.0-6.0	0.11-0.13	5.6-7.8	Low----------	0.24			
	25-60	0-10	1.20-1.45	>20	0.02-0.04	7.4-8.4	Low----------	0.10			
Bz-----------------	0-17	14-27	1.35-1.50	0.6-2.0	0.21-0.24	6.1-7.3	Low----------	0.28	5	6	3-5
Brookston	17-53	20-35	1.40-1.60	0.6-2.0	0.15-0.19	6.1-7.8	Moderate-----	0.28			
	53-60	15-26	1.45-1.70	0.6-2.0	0.05-0.19	7.4-8.4	Low----------	0.28			
Co-----------------	0-8	27-35	1.30-1.60	0.6-2.0	0.21-0.23	6.1-7.3	Moderate-----	0.37	5	5	1-3
Coesse	8-22	27-35	1.40-1.60	0.2-0.6	0.18-0.20	6.1-7.3	Moderate-----	0.37			
	22-34	45-55	1.40-1.65	0.2-0.6	0.09-0.13	6.1-7.3	Moderate-----	0.37			
	34-55	40-55	1.40-1.85	0.2-0.6	0.09-0.13	6.1-7.3	Moderate-----	0.37			
	55-80	27-40	1.40-1.85	0.2-0.6	0.10-0.18	6.1-7.8	Moderate-----	0.37			
CsA----------------	0-8	5-15	1.35-1.50	0.6-2.0	0.13-0.15	5.6-7.3	Low----------	0.24	5	3	1-3
Crosier	8-25	20-33	1.40-1.60	0.2-0.6	0.15-0.19	5.6-8.4	Moderate-----	0.32			
	25-60	10-20	1.40-1.60	0.2-0.6	0.10-0.19	7.3-8.4	Low----------	0.32			
Fu-----------------	0-10	27-40	1.35-1.55	0.2-0.6	0.21-0.23	5.6-7.3	Moderate-----	0.43	3	7	2-3
Fulton	10-25	45-60	1.40-1.70	0.06-0.2	0.09-0.13	5.1-7.3	High---------	0.32			
	25-60	25-50	1.45-1.70	<0.2	0.08-0.12	7.4-8.4	High---------	0.32			
GsB2---------------	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
Glynwood	8-22	35-55	1.45-1.75	0.06-0.2	0.11-0.18	5.6-8.4	Moderate-----	0.32			
	22-60	27-36	1.65-1.85	0.06-0.2	0.06-0.10	7.4-8.4	Moderate-----	0.32			
GtB3---------------	0-9	27-38	1.35-1.55	0.2-0.6	0.17-0.23	5.6-7.3	Low----------	0.43	2	6	.5-2
Glynwood	9-21	35-55	1.45-1.75	0.06-0.2	0.11-0.18	5.6-8.4	Moderate-----	0.32			
	21-60	27-36	1.65-1.85	0.06-0.2	0.06-0.10	7.4-8.4	Moderate-----	0.32			
Gw-----------------	0-11	2-14	1.20-1.60	6.0-20	0.10-0.12	5.6-7.8	Low----------	0.17	5	2	4-6
Granby	11-32	0-14	1.45-1.65	6.0-20	0.05-0.12	6.1-7.8	Low----------	0.17			
	32-60	0-10	1.45-1.65	6.0-20	0.05-0.09	6.6-8.4	Low----------	0.17			
HbA----------------	0-11	12-20	1.30-1.45	0.6-2.0	0.18-0.22	5.6-7.3	Low----------	0.37	4	5	1-4
Haskins	11-27	18-35	1.45-1.70	0.6-2.0	0.12-0.16	5.6-7.3	Low----------	0.37			
	27-60	30-55	1.60-1.80	0.06-0.2	0.08-0.12	6.1-8.4	Moderate-----	0.37			

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	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/cc	In/hr	In/in	pH					Pct
HeG-------------	0-3	20-27	1.20-1.40	0.6-2.0	0.18-0.24	6.6-7.8	Low----------	0.32	4	5	1-2
Hennepin	3-18	18-30	1.30-1.60	0.2-0.6	0.14-0.22	6.6-7.8	Low----------	0.32			
	18-60	18-30	1.45-1.70	0.06-0.2	0.07-0.11	6.6-8.4	Low----------	0.32			
Ho--------------	0-8	10-17	1.35-1.55	0.6-2.0	0.20-0.24	5.6-7.3	Low----------	0.37	4	5	1-3
Homer	8-14	20-35	1.45-1.65	0.6-2.0	0.17-0.19	5.6-7.3	Moderate-----	0.37			
	14-36	17-27	1.45-1.65	0.6-2.0	0.15-0.17	5.6-7.8	Low----------	0.37			
	36-60	1-10	1.65-1.95	>20	0.01-0.04	7.9-8.4	Low----------	0.10			
Hs, Ht----------	0-60	---	0.15-0.45	0.2-6.0	0.35-0.45	5.6-7.8	-------------	----	2	2	>70
Houghton											
KaA, KaB--------	0-9	8-20	1.10-1.65	2.0-6.0	0.10-0.15	5.1-7.3	Low----------	0.24	4	3	1-3
Kalamazoo	9-34	18-35	1.25-1.70	0.6-2.0	0.10-0.18	5.1-7.3	Moderate-----	0.32			
	34-47	2-15	1.50-1.65	6.0-20	0.02-0.08	5.1-7.3	Low----------	0.10			
	47-60	0-10	1.50-1.65	6.0-20	0.01-0.03	7.4-8.4	Low----------	0.10			
MbB, MbC--------	0-10	8-20	1.30-1.45	0.6-2.0	0.20-0.24	5.6-7.3	Low----------	0.37	5	5	1-4
Martinsville	10-36	20-33	1.40-1.60	0.6-2.0	0.16-0.20	5.1-6.5	Moderate-----	0.37			
	36-50	15-25	1.40-1.60	0.6-2.0	0.12-0.17	5.1-6.5	Low----------	0.24			
	50-60	2-20	1.50-1.70	0.6-6.0	0.08-0.17	6.6-8.4	Low----------	0.24			
Md--------------	0-12	---	0.13-0.23	0.6-6.0	0.35-0.45	6.1-8.4	-------------	----		2	25-75
Martisco	12-60	---	---	0.06-2.0	---	7.9-8.4	Low----------	----			
Mg--------------	0-9	12-27	1.30-1.50	0.6-2.0	0.16-0.20	6.1-7.3	Low----------	0.28	5	6	3-6
Mermill	9-39	18-35	1.50-1.69	0.6-2.0	0.12-0.16	5.6-7.3	Moderate-----	0.28			
	39-60	30-55	1.60-1.85	0.06-0.2	0.08-0.10	6.6-8.4	Moderate-----	0.28			
MmB2, MmC2, MmD2, MmE2-----------	0-8	8-20	1.35-1.50	0.6-2.0	0.16-0.18	5.6-7.3	Low----------	0.24	5	3	.5-3
Miami	8-30	25-35	1.45-1.65	0.2-2.0	0.15-0.20	5.6-7.3	Moderate-----	0.37			
	30-60	15-25	1.55-1.90	0.2-0.6	0.05-0.19	7.4-8.4	Moderate-----	0.37			
MoC3, MoD3-------	0-7	27-35	1.35-1.60	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.37	4	6	.5-3
Miami	7-24	25-35	1.45-1.65	0.2-2.0	0.15-0.20	5.6-7.3	Moderate-----	0.37			
	24-60	15-25	1.55-1.90	0.2-0.6	0.05-0.19	7.4-8.4	Moderate-----	0.37			
Ms--------------	0-8	35-40	1.30-1.50	0.6-2.0	0.12-0.23	6.1-7.3	High---------	0.28	5	4	5-6
Milford	8-42	35-42	1.40-1.65	0.2-0.6	0.18-0.20	6.1-7.8	Moderate-----	0.43			
	42-60	20-30	1.50-1.70	0.2-0.6	0.20-0.22	6.6-8.4	Moderate-----	0.43			
MvB2, MvC2, MvD2, MvE2-----------	0-10	22-27	1.35-1.55	0.6-2.0	0.20-0.24	5.6-7.3	Low----------	0.43	3	6	1-3
Morley	10-24	35-50	1.55-1.70	0.2-0.6	0.11-0.15	5.6-8.4	Moderate-----	0.43			
	24-60	27-40	1.60-1.80	0.06-0.2	0.07-0.12	6.1-8.4	Moderate-----	0.43			
MxC3, MxD3, MxE3-	0-9	27-35	1.40-1.60	0.2-0.6	0.18-0.22	5.1-7.3	Moderate-----	0.43	2	7	.5-3
Morley	9-22	35-50	1.55-1.70	0.2-0.6	0.11-0.15	5.6-8.4	Moderate-----	0.43			
	22-60	27-40	1.60-1.70	0.06-0.2	0.07-0.12	6.1-8.4	Moderate-----	0.43			
Mz--------------	0-18	---	0.10-0.21	0.2-6.0	0.35-0.45	5.6-7.3	-------------	----	2	2	>50
Muskego	18-52	18-35	0.30-1.10	0.06-0.2	0.18-0.24	5.6-7.8	Moderate-----	0.28			
	52-60	27-35	1.40-1.85	0.06-0.2	0.06-0.12	6.6-8.4	Moderate-----	0.24			
OmB-------------	0-21	5-12	1.40-1.60	6.0-20	0.10-0.12	5.6-7.3	Low----------	0.17	5	2	1-3
Ormas	21-25	10-20	1.50-1.70	2.0-6.0	0.12-0.14	5.6-7.3	Low----------	0.17			
	25-48	18-25	1.50-1.60	2.0-6.0	0.11-0.14	5.6-7.3	Low----------	0.32			
	48-60	1-8	1.55-1.70	>20	0.03-0.05	7.4-8.4	Low----------	0.15			
OsA-------------	0-10	2-10	1.20-1.60	2.0-6.0	0.10-0.15	5.1-7.3	Low----------	0.24	5	3	.5-3
Oshtemo	10-45	10-18	1.20-1.60	2.0-6.0	0.12-0.19	5.1-7.3	Low----------	0.24			
	45-60	0-15	1.20-1.50	>20	0.02-0.04	7.4-8.4	Low----------	0.10			

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	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/cc	In/hr	In/in	pH					Pct
Pa, Pb----------- Palms	0-23	---	0.25-0.45	0.2-6.0	0.35-0.45	5.1-7.8	-------------	----	2	2	>75
	23-51	7-35	1.45-1.70	0.6-2.0	0.16-0.20	6.1-7.8	Moderate-----	----			
	51-60	0-10	1.50-1.65	6.0-20	0.04-0.10	7.4-8.4	Low----------	----			
Pw--------------- Pewamo	0-11	27-40	1.35-1.55	0.6-2.0	0.17-0.22	6.1-7.3	Moderate-----	0.28	5	6	3-10
	11-47	35-50	1.40-1.70	0.2-0.6	0.12-0.20	6.1-7.8	Moderate-----	0.28			
	47-60	30-40	1.50-1.75	0.06-0.6	0.14-0.18	7.4-8.4	Moderate-----	0.28			
Px*. Pits											
RcA, RcB, RcC---- Rawson	0-9	9-18	1.30-1.45	0.6-2.0	0.12-0.18	5.6-7.3	Low----------	0.24	4	3	.5-3
	9-31	18-35	1.50-1.70	0.6-2.0	0.12-0.16	5.1-6.5	Low----------	0.32			
	31-60	30-55	1.60-1.85	0.06-0.2	0.08-0.12	6.6-8.4	Moderate-----	0.32			
Re--------------- Rensselaer	0-14	11-27	1.30-1.45	0.6-2.0	0.20-0.24	6.1-7.3	Low----------	0.32	5	5	2-8
	14-34	20-35	1.40-1.60	0.6-2.0	0.15-0.20	6.1-7.3	Moderate-----	0.32			
	34-48	10-30	1.40-1.60	0.6-2.0	0.16-0.19	6.6-7.8	Moderate-----	0.32			
	48-50	8-20	1.50-1.70	0.6-2.0	0.10-0.18	6.6-8.4	Low----------	0.43			
RhB, RhC--------- Riddles	0-13	4-14	1.35-1.55	2.0-6.0	0.13-0.15	5.6-7.3	Low----------	0.24	5	3	.5-3
	13-48	18-35	1.40-1.60	0.6-2.0	0.16-0.18	5.6-7.3	Moderate-----	0.32			
	48-60	8-25	1.40-1.60	0.6-2.0	0.05-0.19	6.6-8.4	Low----------	0.32			
Sa--------------- Saranac	0-11	27-33	1.40-1.50	0.2-0.6	0.21-0.24	6.1-7.3	Moderate-----	0.28	5	6	4-8
	11-46	27-41	1.50-1.60	0.2-0.6	0.11-0.20	6.1-7.3	Moderate-----	0.43			
	46-60	3-10	1.70-1.80	2.0-6.0	0.02-0.11	7.4-7.8	Low----------	0.10			
Se--------------- Sebewa	0-13	10-25	1.10-1.60	0.6-2.0	0.18-0.25	6.1-7.3	Low----------	0.24	4	5	1-6
	13-33	18-35	1.50-1.80	0.6-2.0	0.15-0.19	6.1-8.4	Low----------	0.24			
	33-60	0-3	1.55-1.75	6.0-20	0.02-0.04	7.4-8.4	Low----------	0.10			
SfB, SfC--------- Seward	0-10	3-15	1.40-1.60	6.0-20	0.08-0.10	5.1-7.3	Low----------	0.17	4	2	5-3
	10-30	2-15	1.40-1.60	6.0-20	0.05-0.09	5.1-7.3	Low----------	0.17			
	30-35	5-25	1.50-1.70	2.0-6.0	0.10-0.16	6.1-7.3	Low----------	0.17			
	35-60	30-55	1.60-1.82	0.06-0.2	0.06-0.12	6.6-8.4	High---------	0.32			
Sh--------------- Shoals	0-14	18-27	1.30-1.45	0.6-2.0	0.20-0.24	6.1-7.3	Low----------	0.37	5	5	2-4
	14-23	18-27	1.35-1.50	0.6-2.0	0.17-0.19	6.1-7.3	Low----------	0.37			
	23-48	10-20	1.40-1.60	0.6-6.0	0.11-0.13	6.1-7.3	Low----------	0.37			
	48-60	5-10	1.40-1.60	6.0-20	0.03-0.09	6.6-8.4	Low----------	0.17			
So--------------- Sloan	0-18	15-27	1.20-1.40	0.6-2.0	0.20-0.24	6.1-7.3	Low----------	0.37	5	6	3-6
	18-33	20-35	1.25-1.55	0.2-2.0	0.17-0.20	6.1-7.3	Moderate-----	0.37			
	33-54	10-30	1.25-1.55	0.2-2.0	0.19-0.21	6.1-7.3	Low----------	0.37			
	54-60	0-10	1.20-1.50	6.0-20	0.02-0.05	6.6-8.4	Low----------	0.10			
SpB, SpC--------- Spinks	0-11	0-10	1.20-1.60	6.0-20	0.06-0.08	5.6-7.3	Low----------	0.17	5	1	1-4
	11-25	3-15	1.20-1.60	2.0-20	0.05-0.10	5.6-7.3	Low----------	0.17			
	25-74	0-15	1.20-1.50	2.0-6.0	0.04-0.08	5.6-7.3	Low----------	0.17			
	74-80	0-10	1.20-1.50	6.0-20	0.04-0.06	6.6-8.4	Low----------	0.17			
St--------------- Stonelick Variant	0-10	8-18	1.35-1.55	2.0-6.0	0.13-0.18	6.1-7.3	Low----------	0.24	5	3	.5-3
	10-55	5-18	1.45-1.70	2.0-6.0	0.08-0.17	6.1-7.3	Low----------	0.24			
	55-60	1-10	1.45-1.70	6.0-20	0.03-0.12	7.8-8.4	Very low-----	0.10			
Ud*. Udorthents											

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	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/cc	In/hr	In/in	pH					Pct
Wa----------------- Wallkill	0-8	27-35	1.15-1.40	0.6-2.0	0.13-0.17	5.6-7.3	Low----------	0.24	5	---	3-8
	8-21	15-35	1.15-1.40	0.2-2.0	0.15-0.20	5.6-7.3	Low----------	0.32			
	21-60	---	0.25-0.45	0.2-6.0	0.35-0.45	5.6-7.3	-------------	----			
Wc----------------- Wallkill	0-9	27-40	1.30-1.60	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.37	5	5	1-6
	9-22	27-40	1.40-1.60	0.2-0.6	0.18-0.20	5.6-7.3	Moderate-----	0.37			
	22-41	---	0.10-0.30	0.2-6.0	0.35-0.45	5.6-7.3	-------------	----			
	41-60	18-35	0.30-1.10	0.06-0.2	0.18-0.24	5.6-7.3	Moderate-----	0.28			
WmB, WmC--------- Wawasee	0-9	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
	9-31	18-30	1.50-1.70	0.6-2.0	0.12-0.18	5.6-7.3	Low----------	0.28			
	31-60	12-18	1.50-1.70	0.6-2.0	0.11-0.18	6.6-8.4	Low----------	0.28			
Wt----------------- Whitaker	0-14	8-19	1.30-1.45	0.6-2.0	0.20-0.24	5.6-7.3	Low----------	0.37	5	5	1-3
	14-51	18-33	1.40-1.60	0.6-2.0	0.15-0.19	5.1-7.3	Moderate-----	0.37			
	51-60	3-18	1.50-1.70	0.6-6.0	0.19-0.21	6.6-8.4	Low----------	0.37			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "frequent," "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			Subsidence		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Initial	Total		Uncoated steel	Concrete
					Ft			In	In			
Ae----------------- Adrian	A/D	None---------	---	---	+1-1.0	Apparent	Nov-May	---	29-33	High-----	High-----	Moderate.
BmA, BmB2--------- Blount	C	None---------	---	---	1.0-3.0	Perched	Jan-May	---	---	High-----	High-----	High.
Bt----------------- Boots	A/D	None---------	---	---	+1-1.0	Apparent	Nov-Aug	---	40-55	High-----	Moderate	Low.
BvB, BvC, BvD, BwA, BwB, BwC, ByC3------------- Boyer	B	None---------	---	---	>6.0	---	---	---	---	Low------	Low------	Moderate.
Bz----------------- Brookston	B/D	None---------	---	---	+.5-1.0	Apparent	Dec-May	---	---	High-----	High-----	Low.
Co----------------- Coesse	C/D	None---------	---	---	+1-1.0	Apparent	Oct-Jun	---	---	High-----	High-----	Low.
CsA---------------- Crosier	C	None---------	---	---	1.0-3.0	Apparent	Jan-Apr	---	---	High-----	High-----	Low.
Fu----------------- Fulton	D	None---------	---	---	1.0-2.5	Perched	Dec-May	---	---	Moderate	High-----	Moderate.
GsB2, GtB3--------- Glynwood	C	None---------	---	---	2.0-3.5	Perched	Jan-Apr	---	---	High-----	High-----	Moderate.
Gw----------------- Granby	A/D	None---------	---	---	+1-1.0	Apparent	Nov-Jun	---	---	Moderate	High-----	Low.
HbA---------------- Haskins	C	None---------	---	---	1.0-2.5	Perched	Jan-Apr	---	---	High-----	High-----	Moderate.
HeG---------------- Hennepin	B	None---------	---	---	>6.0	---	---	---	---	Moderate	Low------	Low.
Ho----------------- Homer	B	None---------	---	---	1.0-3.0	Apparent	Jan-Apr	---	---	High-----	High-----	High.
Hs, Ht------------- Houghton	A/D	None---------	---	---	+1-1.0	Apparent	Sep-Jun	1-4	55-60	High-----	High-----	Low.
KaA, KaB----------- Kalamazoo	B	None---------	---	---	>6.0	---	---	---	---	Moderate	Low------	Low.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Subsidence		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Initial	Total		Uncoated steel	Concrete
					Ft			In	In			
MbB, MbC---------- Martinsville	B	None--------	---	---	>6.0	---	---	---	---	Moderate	Moderate	Moderate.
Md---------------- Martisco	B/D	Frequent----	Long to very long.	Mar-Jun	+1-0.5	Apparent	Oct-Jun	3-4	4-6	High-----	High-----	Low.
Mg---------------- Mermill	B/D	None--------	---	---	+1-1.0	Perched	Dec-May	---	---	High-----	Moderate	Moderate.
MmB2, MmC2, MmD2, MmE2, MoC3, MoD3- Miami	B	None--------	---	---	>6.0	---	---	---	---	Moderate	Moderate	Moderate.
Ms---------------- Milford	B/D	None--------	---	---	+.5-2.0	Apparent	Mar-Jun	---	---	High-----	High-----	Low.
MvB2, MvC2, MvD2, MvE2, MxC3, MxD3, MxE3------------- Morley	C	None--------	---	---	>6.0	---	---	---	---	Moderate	High-----	Moderate.
Mz---------------- Muskego	D	None--------	---	---	+1-1.0	Apparent	Sep-Jun	3-10	15-30	High-----	Moderate	Moderate.
OmB--------------- Ormas	B	None--------	---	---	>6.0	---	---	---	---	Moderate	Low------	Moderate.
OsA--------------- Oshtemo	B	None--------	---	---	>6.0	---	---	---	---	Low------	Low------	High.
Pa, Pb------------ Palms	A/D	None--------	---	---	+1-1.0	Apparent	Nov-Jun	2-4	25-32	High-----	High-----	High.
Pw---------------- Pewamo	C/D	None--------	---	---	+1-1.0	Apparent	Dec-May	---	---	High-----	High-----	Low.
Px*. Pits												
RcA, RcB, RcC----- Rawson	B	None--------	---	---	2.5-4.0	Perched	Jan-Apr	---	---	Moderate	High-----	High.
Re---------------- Rensselaer	B/D	None--------	---	---	+.5-1.0	Apparent	Dec-May	---	---	High-----	Moderate	Low.
RhB, RhC---------- Riddles	B	None--------	---	---	>6.0	---	---	---	---	Moderate	Moderate	Moderate.

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Subsidence		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Initial	Total		Uncoated steel	Concrete
					Ft			In	In			
Sa----------------- Saranac	C	Frequent----	Brief-----	Dec-May	+.5-1.0	Apparent	Dec-Jun	---	---	High-----	High-----	Low.
Se----------------- Sebewa	B/D	None---------	---	---	+1-1.0	Apparent	Sep-May	---	---	High-----	High-----	Low.
SfB, SfC----------- Seward	B	None---------	---	---	3.0-6.0	Perched	Jan-Apr	---	---	Moderate	High-----	Moderate.
Sh----------------- Shoals	C	Frequent----	Brief-----	Oct-Jun	1.0-3.0	Apparent	Jan-Apr	---	---	High-----	High-----	Low.
So----------------- Sloan	B/D	Frequent----	Brief-----	Nov-Jun	0-1.0	Apparent	Nov-Jun	---	---	High-----	High-----	Low.
SpB, SpC----------- Spinks	A	None---------	---	---	>6.0	---	---	---	---	Low------	Low------	Low.
St----------------- Stonelick Variant	B	Occasional	Brief-----	Mar-Jun	>6.0	---	---	---	---	Moderate	Low------	Low.
Ud*. Udorthents												
Wa----------------- Wallkill	B/D	None---------	---	---	+.5-1.0	Apparent	Sep-Jun	---	---	High-----	Moderate	Moderate.
Wc----------------- Wallkill	C/D	None---------	---	---	+1-1.0	Apparent	Sep-Jun	---	---	High-----	High-----	Low.
WmB, WmC----------- Wawasee	B	None---------	---	---	>6.0	---	---	---	---	Moderate	High-----	Low.
Wt----------------- Whitaker	C	None---------	---	---	1.0-3.0	Apparent	Jan-Apr	---	---	High-----	High-----	Moderate.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 19.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

Soil name	Family or higher taxonomic class
Adrian	Sandy or sandy-skeletal, mixed, euic, mesic Terric Medisaprists
Blount	Fine, illitic, mesic Aeric Ochraqualfs
Boots	Euic, mesic Typic Medihemists
Boyer	Coarse-loamy, mixed, mesic Typic Hapludalfs
Brookston	Fine-loamy, mixed, mesic Typic Argiaquolls
Coesse	Fine, mixed, nonacid, mesic Aeric Fluvaquents
Crosier	Fine-loamy, mixed, mesic Aeric Ochraqualfs
Fulton	Fine, illitic, mesic Aeric Ochraqualfs
Glynwood	Fine, illitic, mesic Aquic Hapludalfs
Granby	Sandy, mixed, mesic Typic Haplaquolls
Haskins	Fine-loamy, mixed, mesic Aeric Ochraqualfs
Hennepin	Fine-loamy, mixed, mesic Typic Eutrochrepts
Homer	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Aeric Ochraqualfs
Houghton	Euic, mesic Typic Medisaprists
Kalamazoo	Fine-loamy, mixed, mesic Typic Hapludalfs
Martinsville	Fine-loamy, mixed, mesic Typic Hapludalfs
*Martisco	Fine-silty, carbonatic, mesic Histic Humaquepts
Mermill	Fine-loamy, mixed, mesic Mollic Ochraqualfs
Miami	Fine-loamy, mixed, mesic Typic Hapludalfs
Milford	Fine, mixed, mesic Typic Haplaquolls
Morley	Fine, illitic, mesic Typic Hapludalfs
Muskego	Coprogenous, euic, mesic Limnic Medisaprists
Ormas	Loamy, mixed, mesic Arenic Hapludalfs
Oshtemo	Coarse-loamy, mixed, mesic Typic Hapludalfs
Palms	Loamy, mixed, euic, mesic Terric Medisaprists
Pewamo	Fine, mixed, mesic Typic Argiaquolls
Rawson	Fine-loamy, mixed, mesic Typic Hapludalfs
Rensselaer	Fine-loamy, mixed, mesic Typic Argiaquolls
Riddles	Fine-loamy, mixed, mesic Typic Hapludalfs
Saranac	Fine, mixed, mesic Fluvaquentic Haplaquolls
Sebewa	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Argiaquolls
Seward	Loamy, mixed, mesic Arenic Hapludalfs
Shoals	Fine-loamy, mixed, nonacid, mesic Aeric Fluvaquents
Sloan	Fine-loamy, mixed, mesic Fluvaquentic Haplaquolls
Spinks	Sandy, mixed, mesic Psammentic Hapludalfs
Stonelick Variant	Coarse-loamy, mixed, nonacid, mesic Typic Udifluvents
Udorthents	Loamy, mixed, nonacid, mesic Udorthents
Wallkill	Fine-loamy, mixed, nonacid, mesic Thapto-Histic Fluvaquents
Wawasee	Fine-loamy, mixed, mesic Typic Hapludalfs
Whitaker	Fine-loamy, mixed, mesic Aeric Ochraqualfs

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