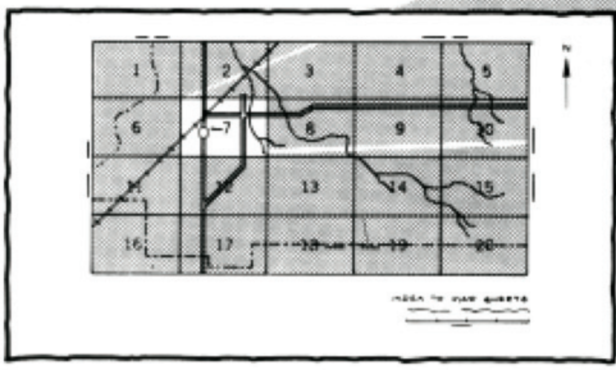
SOIL SURVEY OF

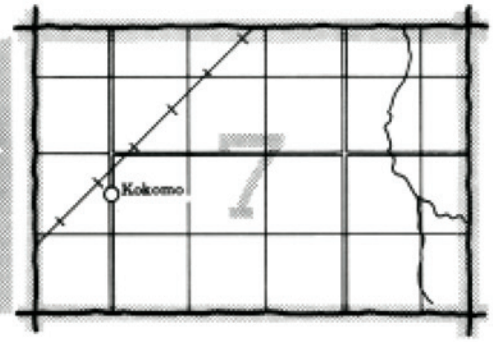
Miami County, Indiana

United States Department of Agriculture
Soil Conservation Service
in cooperation with
Purdue University Agricultural Experiment Station

HOW TO USE

1. Locate your area of interest on the "Index to Map Sheets"





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

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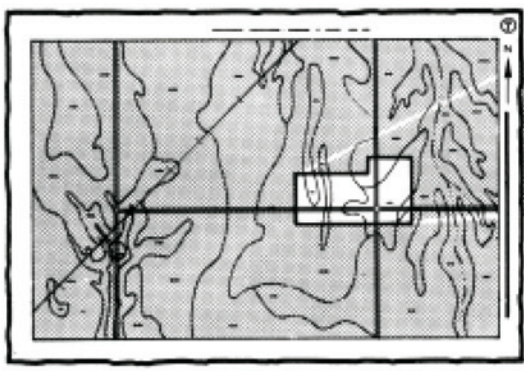

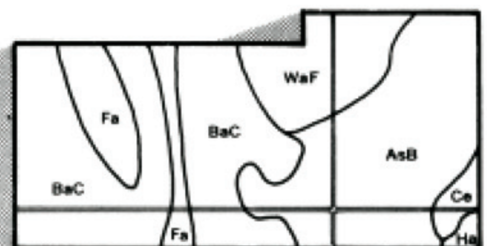

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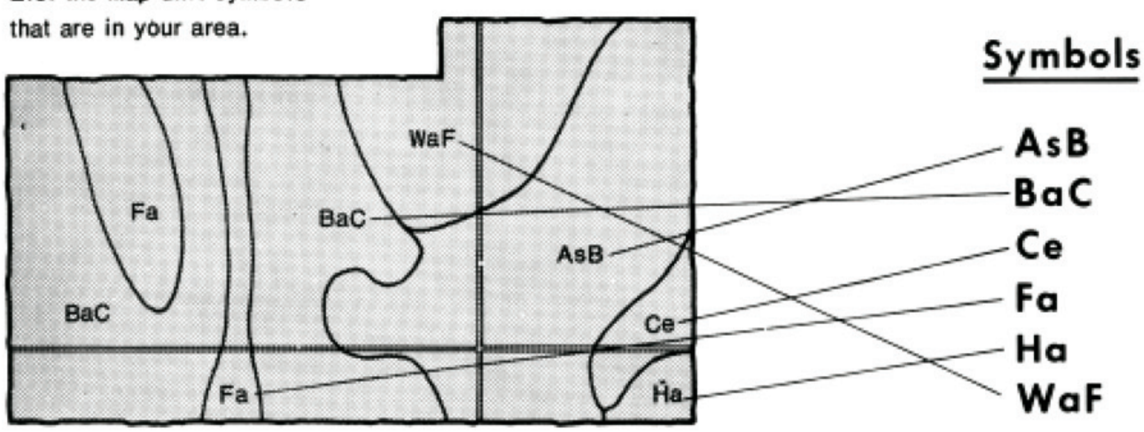
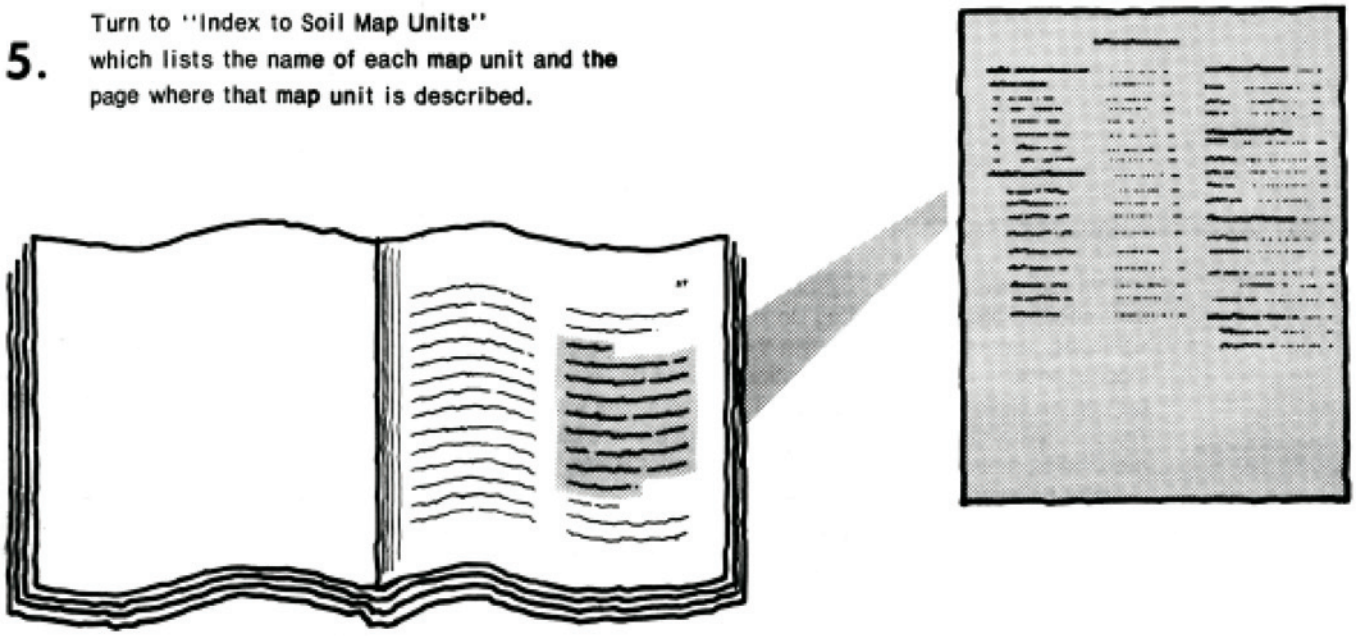
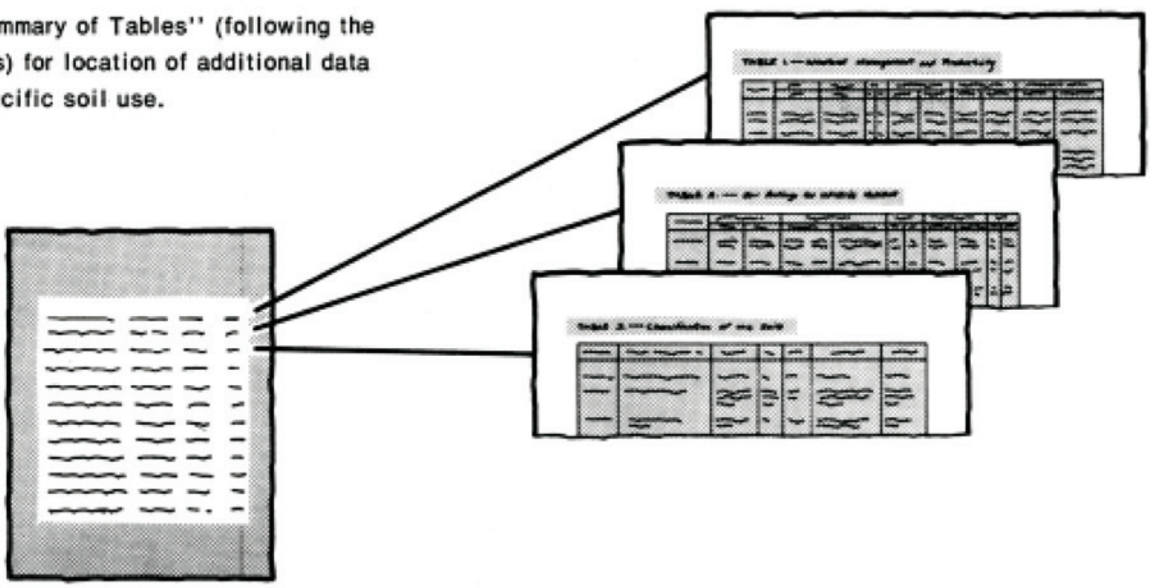


THIS SOIL SURVEY

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



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



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

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

Major fieldwork for this soil survey was completed in the period 1970 to 1976. Soil names and descriptions were approved in February 1977. Unless otherwise indicated, statements in the publication refer to conditions in the survey area in 1976. This survey was made cooperatively by the Soil Conservation Service and the Purdue University Agricultural Experiment Station. It is part of the technical assistance furnished to the Miami County Soil and Water Conservation District. Financial assistance was provided by the Board of County Commissioners of Miami County and the Soil and Water Conservation Committee, Indiana Department of Natural Resources.

Soil maps in this survey may be copied without permission, but any enlargement of these maps can cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

Cover: Sod waterway of Fox silt loam, 2 to 6 percent slopes, reduces erosion, traps sediment, and provides habitat for wildlife.

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Foreword

The Soil Survey of Miami County contains much information useful in any land-planning program. Of prime importance are the predictions of soil behavior for selected land uses. Also highlighted are limitations or hazards to land uses that are inherent in the soil, improvements needed to overcome these limitations, and the impact that selected land uses will have on the environment.

This soil survey has been prepared for many different users. Farmers, foresters, and agronomists can use it to determine the potential of the soil and the management practices required for food and fiber production. Planners, community officials, engineers, developers, builders, and homebuyers can use it to plan land use, select sites for construction, develop soil resources, or identify any special practices that may be needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the soil survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur even within short distances. Soils may be seasonally wet or subject to flooding. They may be moderately deep to bedrock. They may be too unstable to be used as a foundation for buildings or roads. Very clayey or wet soils are poorly suited to 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 kind of soil is shown on detailed soil maps. Each kind of soil in the survey area is described, and much information is given about each soil for specific uses. Additional information or assistance in using this publication can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

This soil survey can be useful in the conservation, development, and productive use of soil, water, and other resources.

Buell M. Ferguson

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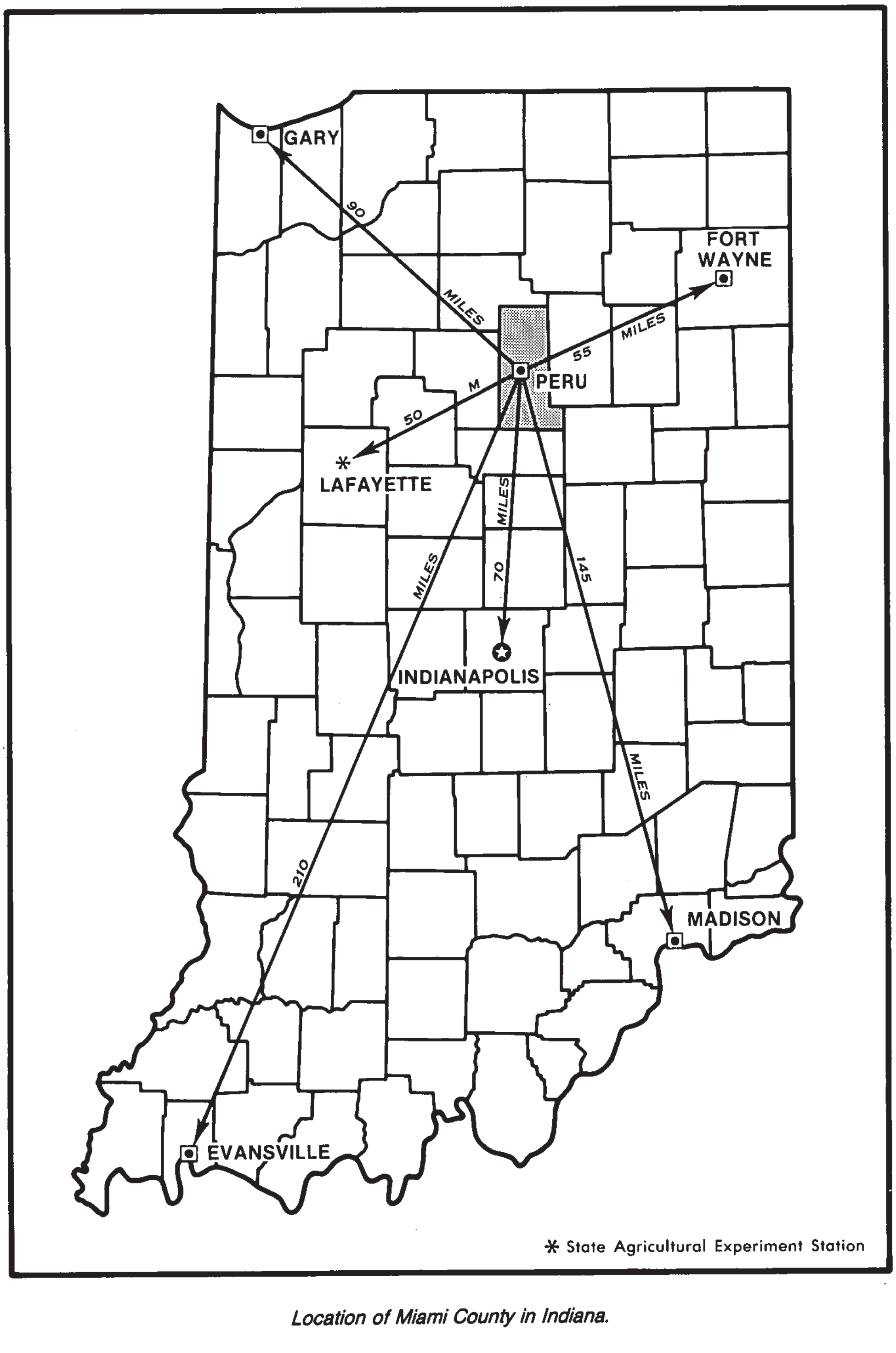
State Conservationist
Soil Conservation Service



Location of Miami County in Indiana.

SOIL SURVEY OF MIAMI COUNTY, INDIANA

By Jack M. Deal, Soil Conservation Service

Fieldwork by Jack M. Deal, Rex A. Brock, and Larry R. Staley, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service,
in cooperation with Purdue University Agricultural Experiment Station

MIAMI COUNTY is in north-central Indiana (see facing page). It has an area of 380 square miles, or 243,200 acres. The county extends about 30 miles from north to south and 12 miles from east to west. The population of Miami County was 39,246 in 1970. Peru, the county seat and largest city, is centrally located. Its population was 14,139 in 1970. Other major trading centers are Bunker Hill in the southwest, Amboy and Converse in the southeast, and Mexico and Denver in the north-central part of the county. Businesses and industries are small, and much of the nonagricultural work force commutes to cities outside the county for employment.

General nature of the county

Miami County consists of two contrasting areas. The southern half is a flat plain dissected by several creeks and numerous small drainageways. It has low relief and few abrupt changes in topography. The northern half is characterized by frequent and abrupt changes in slope. This area is dissected by the Wabash and Eel Rivers, numerous creeks and drainageways, and a large moraine.

About 70 percent of the county is farmed. Corn, soybeans, and small grain are the principal crops. A limited acreage of specialty crops, such as apples and tomatoes, is grown. Limited urban development is important in all parts of the county.

General features that affect soil use in Miami County are discussed on the following pages.

Physiography, relief, and drainage

Miami County has four physiographic subdivisions: the upland till plain, the Packerton moraine, the outwash terraces, and the bottom lands.

Most extensive is the upland till plain in the southern half of the county. The area is strikingly uniform in surface features. It is nearly level except along major stream valleys, where it grades from gently sloping to very steep. Most of the till plain is between 780 and 820 feet above sea level. The creeks and rivers are 50 to 150 feet lower. There are very few natural drainageways on the till plain. Excess water is removed from most soils by an elaborate system of subsurface tile drainage and open drainage ditches.

The Packerton moraine (*4*) extends over much of the northern third of the county. It is characterized by frequent and abrupt changes in slope (fig. 1), surface texture, and land use (fig. 2). Slopes are inconsistent in length, size, and shape and range from nearly level to moderately steep within short distances. Many irregularly shaped areas of muck are in deep depressions and potholes. The sides of hills are commonly eroded and clayey. Small seepage areas are common. The tops of many hills and ridges are loamy or sandy. The sloping soils are well drained, but some small hillside seeps and some minor drainageways need random tile drainage.

There are few natural drainageways in the irregularly shaped deep depressions and potholes. In many of these areas, open drainage ditches have to be deep and extend for great distances to a suitable outlet. An elaborate system of open ditches, tile, and pump drainage individually or in combination is often necessary to drain the soil adequately for crop production. Many of these areas that were once used for crops are reverting back to marsh.

Outwash terraces are most extensive along the Eel, Wabash, and Mississinewa Rivers. There are many small, isolated areas of terraces along the creek valleys. The Eel River terrace is the largest. It varies from 1 1/2 to 2 miles wide at most places. Another large area is west of the city of Peru and is 30 to 40 feet above the adjacent land. There are few natural drainageways on the outwash terraces. Most of the soils in these areas are well drained, and surface runoff is slow. Water intake is rapid, and permeability is moderate or moderately rapid in the subsoil and rapid in the underlying gravelly sand and sand. A few areas of somewhat poorly drained and poorly drained soils are on the outwash terraces. Random tile lines and a few open drainage ditches are adequate to drain these areas for crop production. Most of the open ditches serve as outlets for surface runoff from the higher lying uplands.

Bottom lands are nearly level and occur along the rivers and creeks. The Wabash River bottom land east of Peru is the largest. It varies from 1 1/2 to 2 miles wide at most places and is intensively used for row crops. The bottom land along Eel River is discontinuous and is less than one-quarter mile wide at most places. The bottom land along the creeks is narrow and is often used as woodland or pasture. Open drainage ditches are common on the bottom lands and carry mainly surface runoff from higher lying uplands to the rivers or creeks.

Climate

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

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

In winter the average temperature is 27 degrees F, and the average daily low is 18 degrees. The lowest temperature on record, which occurred at Wabash on January 2, 1969, is 23 degrees below zero. In summer the average temperature is 70 degrees, and the average daily high is 83 degrees. The highest recorded temperature, which occurred on July 15, 1954, is 101 degrees.

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

Of the total annual precipitation, 23 inches, or 60 percent, usually falls from April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall from April through September is less than 19 inches. The heaviest 1-day rainfall during the period of record was 4.78 inches at Wabash on July 8, 1964. Thunderstorms occur on about 40 days each year, mostly in summer.

Average seasonal snowfall is 29 inches. The greatest snow depth at any one time during the period of record was 15 inches. On the average, 19 days have at least 1 inch of snow on the ground, but the number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 65 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The proportion of possible sunshine is 70 percent in summer and 40 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, 12 miles per hour, in March.

Tornadoes and severe thunderstorms occur occasionally. These storms are usually local and of short duration and cause damage in a variable pattern.

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

Transportation

About 42 miles of four-lane highway run through Miami County. U.S. Highway 31 is on the west side of the county and is the main north-south road. U.S. Highway 24 runs east and west through the center of the county. Several secondary State highways connect the rural population centers. About 64 percent of the 760 miles of county road is hard surfaced and 36 percent is all-weather gravel road.

Two main railroad lines with about 100 miles of tracks cross the county. They radiate from two switching yards in Peru. Almost all towns and villages are served by one of the lines. Amtrak daily passenger service is available in Peru.

One municipal airport and several small airfields serve small private airplanes.

Settlement and land use

Miami County was organized in 1834. Explorers, traders, and settlers used the area for many years prior to organization. Early settlements in the county were along the rivers and major creeks. The streams were used by traders and farmers to float their goods to market. The next areas to be settled were the well drained terraces and rolling areas in the northern part of the county. Most areas in the southern half of the county were swamp and therefore were settled more slowly. These areas had to be cleared of dense forests and artificially drained before the soils could be used for crops.

Agriculture provides the main sources of income and employment in Miami County. Approximately 56 percent of farm income is from the sale of grain crops, mainly corn and soybeans. A large amount of the grain is used locally for livestock feed. The acreage in crops varies from year to year, but generally about 68,000 acres of corn, 46,000 acres of soybeans, and 13,000 acres of wheat are grown. Approximately 44 percent of the farm income in the county is from the sale of livestock or livestock products. Cattle, hogs, and dairy are the primary livestock enterprises. Sheep and poultry are less common.

How this survey was made

Soil scientists made this survey to learn what kinds of soil are in the survey area, where they are, and how they can be used. The soil scientists went into the area knowing they likely would locate many soils they already knew something about and perhaps identify some they had never seen before. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material, which has been changed very little by leaching or by the action of plant roots.

The soil scientists recorded the characteristics of the profiles they studied, and they compared those profiles with others in counties nearby and in places more distant. Thus, through correlation, they classified and named the soils according to nationwide, uniform procedures.

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

The areas shown on a soil map are called soil map units. Some map units are made up of one kind of soil, others are made up of two or more kinds of soil, and a few have little or no soil material at all. Map units are discussed in the sections "General soil map for broad land-use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of soils are taken as needed for laboratory measurements and for engineering tests. The soils are field tested, and interpretations of their behavior are modified as necessary during the course of the survey. New interpretations are added to meet local needs, mainly through field observations of different kinds of soil in different uses under different levels of management. Also, data are assembled from other sources, such as test results, records, field experience, and information available from state and local specialists. For example, data on crop yields under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it is readily available to different groups of users, among them farmers, managers of woodland, engineers, planners, developers and builders, homebuyers, and those seeking recreation.

General soil map for broad land use planning

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

The general soil map provides a broad perspective of the soils and landscapes in the survey area. It provides a basis for comparing the potential of large areas for general kinds of land use. Areas that are, for the most part, suited to certain kinds of farming or to other land uses can be identified on the map. Likewise, areas of soils having properties that are distinctly unfavorable for certain land uses can be located.

Because of its small scale, the map does not show the kind of soil at a specific site. Thus, it 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 kinds of soil in any one map unit differ from place to place in slope, depth, stoniness, drainage, or other characteristics that affect their management.

The soils in the survey area vary widely in their potential for major land uses. Table 4 shows the extent of the map units shown on the general soil map and gives general ratings of the potential of each, in relation to the other map units, for major land uses. Soil properties that pose limitations to the use are indicated. The ratings of soil potential are based on the assumption that practices in common use in the survey area are being used to overcome soil limitations. These ratings reflect the ease of overcoming the soil limitations and the probability of soil problems persisting after such practices are used.

Each map unit is rated for *cultivated farm crops, woodland, urban uses,* and *recreation areas.* Cultivated farm crops are those grown extensively by farmers in the survey area. Woodland refers to land that is producing either trees native to the area or introduced species. Urban uses include residential, commercial, and industrial developments. Intensive recreation areas include campsites, picnic areas, ballfields, and other areas that are subject to heavy foot traffic. Extensive recreation areas include those used for nature study and as wilderness.

The names, descriptions, and delineations of units on the general soil map of this county do not always agree or coincide fully with those of adjoining counties published earlier. This difference is partially the result of changes in concepts of soil series and in the application of the soil classification system. Other differences stem from differences in the proportions of soils in map units made up of two or three series. Still other differences are caused by the range in slope allowed within the map units of adjoining surveys. Also, a map unit in an adjacent county can be too small to be delineated in this county.

Descriptions of the map units

1. Fincastle-Treaty

Deep, nearly level, somewhat poorly drained and poorly drained, medium textured soils on uplands

This unit consists of nearly level soils on upland glacial till plains. These soils are on broad flats or very low ridges and in slight depressions, swales, or wide and shallow drainageways.

This map unit occupies about 8 percent of the county. It is about 46 percent Fincastle soils, 39 percent Treaty soils, and 15 percent soils of minor extent.

Fincastle soils are somewhat poorly drained. They are on the higher lying broad flats and low ridges in the landscape. Treaty soils are poorly drained. They are in drainageways. Fincastle and Treaty soils have a silt loam surface layer and a seasonal high water table.

The minor soils in this map unit are along the small creek valleys. They are somewhat poorly drained Shoals soils on flood plains, well drained Ockley and Fox soils on stream terraces, and well drained Miami soils on valley sides and along drainageways.

This unit is used mainly for corn and soybeans. A small acreage is used for small grain, tomatoes, pasture, and woodland. Most areas have been artificially drained, but there are a few swampy, undrained areas. Wetness is the main limitation on use of these soils for farming and for most other purposes. Ponding or flooding of the Treaty soils is common in winter and spring.

This unit, if adequately drained, has good potential for the cultivated farm crops commonly grown in the county. Wetness and slow and moderately slow permeability are such severe limitations and so difficult to overcome that the potential for sanitary facilities and building sites is poor.

2. Blount-Pewamo

Deep, nearly level and gently sloping, somewhat poorly drained and very poorly drained, medium textured and moderately fine textured soils on uplands

This unit consists of nearly level and gently sloping soils on upland glacial till plains. These soils are on broad flats or very low ridges and in slight depressions, swales, or wide and shallow drainageways.

This map unit occupies about 31 percent of the county. It is about 58 percent Blount soils, 35 percent Pewamo soils, and 7 percent soils of minor extent.

Blount soils are somewhat poorly drained. They are on higher lying broad flats and low ridges in the landscape. They have a silt loam surface layer. Pewamo soils are very poorly drained. They are in slight depressions, swales, or wide and shallow drainageways. They have a surface layer of silty clay loam. Blount and Pewamo soils have a seasonal high water table.

The minor soils in this map unit are the moderately well drained Morley soils, poorly drained Patton soils, and somewhat poorly drained Shoals soils. Morley soils are on low knolls and sides of minor drainageways. Shoals soils are on narrow flood plains. Patton soils are on old shallow lakebeds that are slightly lower than the surrounding landscape.

This unit is used mainly for corn and soybeans. A small acreage is used for small grain, woodland, pasture, and tomatoes. Most areas have been artificially drained, but there are a few swampy, undrained areas. Wetness is the main limitation on use of these soils for farming and for most other purposes. Flooding or ponding of the Pewamo soils is common in winter and spring.

This unit, if adequately drained, has good potential for the cultivated farm crops commonly grown in the county. Wetness and slow and moderately slow permeability are such severe limitations and so difficult to overcome that the potential for sanitary facilities and building sites is poor.

3. Morley-Hennepin

Deep, gently sloping to very steep, moderately well drained and well drained, medium textured and moderately fine textured soils on uplands

This unit consists of gently sloping to very steep soils on upland glacial till plains. These soils are on knolls, ridges, and sides of drainageways.

This map unit occupies about 14 percent of the county. It is about 65 percent Morley soils, 15 percent Hennepin soils, and 20 percent soils of minor extent.

Morley soils are moderately well drained and gently sloping to moderately steep. They are on knolls, ridges, and sides of minor drainageways. These soils have a silt loam and silty clay loam surface layer. Hennepin soils are well drained and moderately steep to very steep. They are between the flood plains and uplands, and in V-shaped valleys on the till plain. These soils have a silt loam surface layer. Morley and Hennepin soils are deep and have a deep water table.

The minor soils in this unit are the somewhat poorly drained Blount soils on uplands, the well drained Ockley soils on stream terraces, and the somewhat poorly drained Shoals soils on narrow flood plains.

This unit is used mainly for crops in rotation, but many large tracts are used for pasture, woodland, urban development, and recreation. The gently sloping and moderately sloping soils are used mainly for crops. The strongly sloping and moderately steep soils are used mainly for pasture or hay, and the steep and very steep soils are used mainly for woodland. Surface runoff and erosion are the major hazards for farming.

If adequately protected from surface runoff and erosion, the gently and moderately sloping part of this unit has fair potential for cultivated crops. The moderately sloping to moderately steep areas are suited to pasture, and the moderately steep to very steep areas are well suited to woodland and woodland wildlife habitat. Steep slope and moderately slow or slow permeability are severe limitations. The potential for sanitary facilities and building sites is poor.

4. Gessie-Shoals

Deep, nearly level, well drained and somewhat poorly drained, medium textured soils on flood plains

This unit consists of nearly level soils on flood plains. These soils are on slightly elevated flats and rounded swells and in slightly depressional swales. The areas are long and are adjacent to rivers and major creeks.

This map unit occupies about 8 percent of the county. It is 33 percent Gessie soils, 33 percent Shoals soils, and 34 percent soils of minor extent.

Gessie soils are well drained and have a deep water table. They are on the slightly elevated broad flats and rounded swells. They are the dominant soil on the wide flood plains of rivers. Shoals soils are somewhat poorly drained and have a seasonal high water table. They are in slightly depressional swales on the flood plains of rivers. They are the dominant soil on the narrow flood plains of creeks. Gessie and Shoals soils have a silt loam surface layer.

The minor soils in this map unit are the very poorly drained Palms, Milford, Millsdale, and Sloan soils in deeper depressions and low-lying pockets. The well drained Ross soils are on slight rises adjacent to valley walls. The well drained Stonelick soils are on slight rises near the stream channel.

This unit is used mainly for cultivated crops. Most areas have been cleared and drained, and are used for corn. A few areas remain in woodland or pasture. Flooding is the main limitation for farming and most other purposes. Wetness and a seasonal high water table are also limitations on Shoals soils.

This unit, if protected by levees and large flood control dams, has good potential for cultivated crops. Flooding is such a severe hazard and so difficult to overcome that the potential for sanitary facilities and building sites is poor.

5. Fox-Oshtemo

Nearly level to strongly sloping, well drained, medium textured and moderately coarse textured soils that are moderately deep or deep over sand and gravel, on outwash terraces

This unit consists of nearly level to strongly sloping soils on outwash river terraces (fig. 3). The nearly level areas are interrupted by gently sloping mounds and ridges and minor drainageways on the Eel River terrace. The moderately sloping and strongly sloping areas are generally adjacent to bottom lands or upland valley walls. Common, flat-topped hills of various size and 10 to 40 feet high rise abruptly along the Wabash River terrace.

This map unit occupies about 8 percent of the county. It is about 30 percent Fox soils, 26 percent Oshtemo soils, and 44 percent soils of minor extent.

Fox soils are well drained and have a silt loam or clay loam surface layer. They are mainly along river terraces. Oshtemo soils are well drained and gently sloping and have a sandy loam surface layer. They are on small, isolated mounds or ridges. Fox and Oshtemo soils are mixed and scattered in a random pattern on terraces. They are underlain by gravelly sand and sand and have a deep water table.

The minor soils in this unit are the well drained Ormas and Oshtemo loamy sand and Chelsea fine sand on flat areas and knolls or ridges. Rensselaer and Sebewa soils are in the lower lying swales, and the somewhat poorly drained Sleeth soils are on slight rises near Rensselaer soils. The well drained Gessie and Stonelick soils are on flood plains.

This unit is used mainly for cultivated crops. A few areas are in woodland or pasture. Droughtiness is the main limitation to use of these soils for farming. Erosion is a hazard on the gently sloping to strongly sloping part, and wind erosion is a limitation on the loamy sand and sand soils.

This unit has fair potential for cultivated crops. The amount and distribution of rainfall during the growing season is an important factor in crop production. The potential for sanitary facilities and building sites is good.

6. Morley-Blount-Pewamo

Deep, nearly level to moderately steep, moderately well drained, somewhat poorly drained, and very poorly drained, medium textured and moderately fine textured soils on uplands

This unit consists of nearly level to moderately steep soils on the Packerton moraine characterized by a topography that has frequent changes in slope (fig. 4). The hills have considerable variation in height, shape, and size.

This map unit occupies about 17 percent of the county. It is about 47 percent Morley soils, 15 percent Blount soils, 13 percent Pewamo soils, and 25 percent soils of minor extent.

Morley soils are moderately well drained and have a surface layer of silt loam and silty clay loam. They are on knolls and ridges, around sloughs and potholes, and along drainageways. Blount soils are somewhat poorly drained and nearly level and have a surface layer of loam and silt loam. Pewamo soils are very poorly drained and have a surface layer of silty clay loam. They are in more depressional areas, in swales, along poorly defined drainageways, and around the edges of sloughs and potholes.

The minor soils in the unit are the well drained Metea soils on low knolls or ridges and the very poorly drained Houghton, Rensselaer, and Washtenaw soils in deep depressions, sloughs, and potholes and along the valleys of creeks and drainageways.

This unit is used mainly for cultivated crops and for grass and legume forage. Some areas are used for woodland. Most wooded areas are swampy and undrained or moderately sloping to moderately steep. Erosion is the main hazard on the gently sloping to moderately steep soils if they are farmed. Wetness is the main limitation on the nearly level soils if they are used for farming and most other purposes. Ponding or flooding is common in winter and spring.

The sloping areas in this unit have fair potential for cultivated crops and good potential for forage grasses and legumes. The nearly level areas in this unit, if adequately drained, have good potential for cultivated crops. Wetness is such a severe limitation and is so difficult to overcome, especially in the sloughs, potholes, and other areas that have impeded drainage, that the potential for sanitary facilities and building sites is poor. Wet areas must be adequately drained if they are to be used for urban development.

7. Wawasee-Crosier-Brookston

Deep, nearly level to strongly sloping, well drained, somewhat poorly drained, and very poorly drained, medium textured and moderately coarse textured soils on uplands

This unit consists of nearly level to strongly sloping soils on till plains and moraines. The moraine is characterized by a topography that has frequent changes in slope (fig. 5). The hills are variable in height, shape, and size. The till plain is interrupted by gently sloping to strongly sloping areas along small creeks and drainageways and small knolls and ridges.

The map unit occupies about 14 percent of the county. It is about 30 percent Wawasee soils, 16 percent Crosier soils, 15 percent Brookston soils, and 39 percent soils of minor extent.

Wawasee soils are well drained and have a surface layer of sandy loam or loam. They are on knolls and ridges, around sloughs and potholes, and along drainageways. Crosier soils are somewhat poorly drained and nearly level and have a surface layer of loam. Brookston soils are very poorly drained and have a surface layer of loam. They are in more depressional areas, in swales, along poorly defined drainageways, and around the edges of sloughs and potholes. Crosier and Brookston soils have a seasonal high water table.

The minor soils in the unit are the moderately well drained Morley, the well drained Metea, and the excessively drained Chelsea soils on knolls and ridges and along drainageways; the very poorly drained Houghton and Palms soils in deep depressions, sloughs, and potholes and in some small stream valleys; and the very poorly drained Rensselaer, Gilford, and Washtenaw soils in slightly depressional areas on the till plain, along open drainage ditches, and around the edges of large deposits of organic soils and on slight rises near Houghton and Palms soils.

This unit is used mainly for cultivated crops. Some areas are used for forage grasses and legumes or for woodland. Most wooded areas are swampy and undrained or moderately sloping and strongly sloping. Erosion is the main hazard on the gently sloping to strongly sloping soils if they are farmed. Wetness is the main limitation on nearly level soils if they are used for farming and most other purposes. Ponding or flooding is common in winter and spring, especially on soils that have impeded drainage.

The sloping areas in this unit have fair potential for cultivated crops and good potential for forage grasses and legumes. The nearly level areas, if adequately drained, have good potential for cultivated crops. Wetness is such a severe limitation and is so difficult to overcome, especially in the sloughs, potholes, and other areas that have impeded drainage, that the potential for sanitary facilities and building sites is poor. Wet areas must be adequately drained if they are to be used for urban development.

Broad land use considerations

Deciding which land should be used for urban development is an issue in the survey area. Each year land is developed for urban uses in Peru, Erie, Jefferson, Butler, Washington, Pipe Creek, and Deer Creek Townships. About 14,000 acres, or nearly 6 percent of the survey area, is urban, built-up, or recreational land. The general soil map is most helpful for planning the general outline of urban areas; it cannot be used for the selection of sites for specific urban structures.

In table 4 the potential and limitations of each map unit for specific uses is given. This data about specific soils in this survey area can be helpful in planning future land use.

Areas where the soils are so unfavorable that urban development is not desirable or nearly prohibitive are extensive in the survey area. The Gessie-Shoals map unit is on flood plains where flooding is a severe hazard. Extensive drainage is required on the wet Fincastle-

Treaty and Blount-Pewamo map units. The Morley-Hennepin map unit is poor for urban development because of slow permeability and steepness of slope. The Wawasee-Crosier-Brookston map unit is dominantly poor, but the less sloping Wawasee soils are good. The Morley-Blount-Pewamo unit is poor for urban development because of wetness and slow permeability.

In large areas of the county are soils that can be developed for urban uses at lower costs than the soils named above. These include large parts of the Fox-Oshtemo map unit. Also, the less sloping Wawasee part of the Wawasee-Crosier-Brookston unit has good potential for urban development. The less sloping Morley parts of the Morley-Blount-Pewamo and Morley-Hennepin units can be developed for urban uses.

In some areas the soils have good potential for cultivated crops but poor potential for urban uses. These soils are in the Fincastle-Treaty, Blount-Pewamo, and Wawasee-Crosier-Brookston general soil map units. In these map units Fincastle, Treaty, Blount, Pewamo, Crosier, and Brookston soils are dominant. Wetness, ponding, and permeability limit nonfarm uses of these soils, but with proper drainage, shaping of the surface, and other engineering practices, these limitations can be overcome. The soils have good potential for farming, and most farmers have provided sufficient drainage for farm crops.

Most of the soils in the county have good potential for woodland. Commercially valuable trees are less common and generally do not grow so rapidly on the wetter soils of the Fincastle-Treaty, Blount-Pewamo, Gessie-Shoals, Morley-Blount-Pewamo, and Wawasee-Crosier-Brookston map units as they do on the soils in the other units. Most stands of trees have been harvested several times. The acreage of woodland is decreasing in the county, especially on nearly level to strongly sloping soils that can be used for cultivated crops. The remaining continuous tracts of woodland are on the Morley-Hennepin map unit. Small tracts are common in the other units but generally are confined to soils that are poorly drained or are too steep to farm.

The Morley-Hennepin map unit has fair potential as sites for parks, camp grounds, picnic facilities, and other intensive recreational uses. Hardwood forests enhance the beauty of much of this unit. The Gessie-Shoals and Fox-Oshtemo units have good potential for intensive recreational areas. The other units are rated fair because of wetness.

All of the soils of the county have good potential for extensive recreational use. Each map unit provides its own uniquely different environment for nature study. The Morley-Blount-Pewamo and Wawasee-Crosier-Brookston units provide a mixture of small undrained swamps and marshes, clay hills, sandhills, farmland that includes cultivated cropland, pasture and hayland, and woodland. The Gessie-Shoals and Fox-Oshtemo units are broad flat areas interrupted only by sandy hills and river valleys. The Gessie-Shoals unit is on a river flood plain, and the Fox-Oshtemo unit is on an outwash terrace. The Morley-Hennepin map unit is well drained soils that have a variety of slopes and plant cover and are used for general farming and some urban development. Large hardwood forests enhance the beauty of this unit. The Fincastle-Treaty and Blount-Pewamo map units are used largely for clean-cultivated crops and for some small woodlots. Although different from the other areas, these map units also have value for nature study. All of the map units provide habitat for many important species of wildlife. Because of the variety of land conditions and farming operations, the Morley-Hennepin, Morley-Blount-Pewamo, and Wawasee-Crosier-Brookston units have more wildlife than the other areas.

Soil maps for detailed planning

The map units shown on the detailed soil maps at the back of this publication represent the kinds of soil in the survey area. They are described in this section. The descriptions together with the soil maps can be useful in determining the potential of a soil and in managing it for food and fiber production; in planning land use and developing soil resources; and in enhancing, protecting, and preserving the environment. More information for each map unit, or soil, is given in the section "Use and management of the soils."

Preceding the name of each map unit is the symbol that identifies the soil on the detailed soil maps. Each soil description includes general facts about the soil and a brief description of the soil profile. In each description, the principal hazards and limitations are indicated, and the management concerns and practices needed are discussed.

The map units on the detailed soil maps represent an area on the landscape made up mostly of the soil or soils for which the unit is named. Most of the delineations shown on the detailed soil map are phases of soil series.

Soils that have profiles that are almost alike make up a *soil series.* Except for allowable differences in texture of the surface layer or of the underlying substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement in the profile. A soil series commonly is named for a town or geographic feature near the place where a soil of that series was first observed and mapped. The Brookston series, for example, was named for the town of Brookston in White County.

Soils of one series can differ in texture of the surface layer or in the underlying substratum and in slope, erosion, stoniness, wetness, or other characteristics that affect their use. On the basis of such differences, a soil series is divided into phases. The name of a *soil phase* commonly indicates a feature that affects use or management. For example, Morley silt loam, 2 to 6 percent slopes, is one of several phases within the Morley series.

Some map units are made up of two or more dominant kinds of soil. Such map units are called soil complexes.

A *soil complex* consists of areas of two or more soils that are so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area includes some of each of the two or more dominant soils, and the pattern and proportion are somewhat similar in all areas. Ormas-Oshtemo loamy sands, 2 to 8 percent slopes, is an example of a complex.

Most map units include small, scattered areas of soils other than those that appear in the name of the map unit. Some of these soils have properties that differ substantially from those of the dominant soil or soils and thus could significantly affect use and management of the map unit. These soils are described in the description of each map unit. Some of the more unusual or strongly contrasting soils that are included are identified by a special symbol on the soil map.

Most mapped areas include places that have little or no soil material and support little or no vegetation. Such places are called *miscellaneous areas*; they are delineated on the soil map and given descriptive names. Pits, quarry, limestone, is an example. Some of these areas are too small to be delineated and are identified by a special symbol on the soil map.

The acreage and proportionate extent of each map unit are given in table 5, and additional information on properties, limitations, capabilities, and potentials for many soil uses is given for each kind of soil in other tables in this survey. (See "Summary of tables.") Many of the terms used in describing soils are defined in the Glossary.

Au—Aubbeenaubbee sandy loam, 0 to 2 percent slopes. This soil is nearly level, deep, and somewhat poorly drained. It is on slightly convex rises in the broad, gently undulating upland till plains. Areas are irregularly shaped and range from 3 to 25 acres in size.

In a typical profile the surface layer is dark grayish brown sandy loam about 10 inches thick. The subsurface layer is light brownish gray sandy loam about 4 inches thick. The subsoil is about 34 inches thick. The upper part is light brownish gray, very friable sandy loam; the middle part is dark yellowish brown, mottled, firm sandy clay loam; and the lower part is yellowish brown and dark yellowish brown, mottled, firm clay loam. The underlying material, to a depth of 60 inches, is calcareous, olive, mottled, friable loam. In some places the sandy loam is less than 18 inches thick. In some places the surface layer is loamy sand.

Included with this soil in mapping are many small areas of Crosier loam. Also included are small areas of Brookston loam in slight depressions and narrow drainageways. These soils dry out more slowly in spring than the Aubbeenaubbee soil. Also included are some areas of Metea loamy sand and Wawasee sandy loam that have slopes of 2 to 6 percent on small knolls or in narrow strips along minor drainageways. These soils dry out more quickly in spring and by late summer often lack sufficient soil moisture for optimum crop growth. In some places small wet areas are included.

Available water capacity is moderate, and permeability is moderate. The organic matter content of the surface layer is moderate. Surface runoff is slow.

Most of the acreage of this soil is farmed. Most areas are used for corn and soybeans. A few areas are used for grass and legume forage, small grain, and small woodlots. If drained, this soil has good potential for crops. It has poor potential for sanitary facilities and building sites.

This soil is well suited to corn, soybeans, and small grain. Wetness is the major limitation, but droughtiness is a slight limitation during extended dry periods. If the soil is adequately drained, row crops can be grown most of the time. Minimum tillage, using crop residue and growing cover crops help to maintain and improve organic matter content and maintain good tilth.

This soil is well suited to grasses for hay and pasture but is poorly suited to deep rooted legumes such as alfalfa because of wetness and a high water table in spring. If this soil is used for pasture, the major concerns of management are overgrazing and grazing when the soil is wet. Grazing when the soil is wet causes surface compaction and poor tilth. Stocking at proper rates, pasture renovation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to trees, but only a few areas are in woodland. Most wooded areas are grazed. The soil is moderately limited by plant competition. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling.

This soil has severe limitations for building sites because of a seasonal high water table. An adequate drainage system and storm sewers are needed to lower the water table. Dwellings and small buildings should be constructed without basements, and foundations and footings should be designed to prevent structural damage caused by shrinking and swelling. Limitations for local roads and streets are severe because of wetness, low strength, and frost action. The base can be strengthened with suitable material. Excess water can be removed by ditches. This soil has severe limitations for septic tank absorption fields because of the seasonal high water table. This water table can be lowered by an adequate drainage system.

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

Ba—Blount loam, 1 to 3 percent slopes. This soil is nearly level and gently sloping, deep, and somewhat poorly drained. It is on convex rises in the broad, undulating till plains and moraine. Areas are irregularly shaped and range from 3 to 80 acres in size.

In a typical profile the surface layer is dark grayish brown loam about 9 inches thick. The subsoil is mottled, firm clay loam about 31 inches thick. The upper part is yellowish brown, and the lower part is grayish brown. The underlying material, to a depth of 60 inches, is light olive brown, mottled clay loam. In some places the surface layer is sandy loam. In some steeper areas, the upper part of the subsoil is less mottled. In small areas the underlying glacial till is loam.

Included with this soil in mapping are small, narrow areas of very poorly drained Pewamo soils in shallow depressions and drainageways. Also included are moderately well drained, gently sloping Morley soils in small areas on knolls or in narrow areas along the sides of small drainageways. These soils dry out more quickly in spring than the Blount soil.

Available water capacity is high, and permeability is slow or moderately slow. The organic matter content of the surface layer is moderate. Surface runoff is medium. The water table is at a depth of 1 to 3 feet in winter and spring and restricts the depth to which plant roots penetrate.

Most of the acreage of this soil is farmed. Most areas are used for rotation cropping. Corn, soybeans, small grain, and forage grasses and legumes are the main crops. A few areas are used as woodland. If drained, this soil has good potential for crops. It has poor potential for sanitary facilities and building sites.

This soil is well suited to corn, soybeans, and small grain. Wetness and slow or moderately slow permeability are the major limitations. If the soil is adequately drained, row crops can be grown most of the time. Minimum tillage, using crop residue, and growing cover crops help to reduce surface runoff and erosion, maintain and improve organic matter content, and maintain good tilth.

This soil is well suited to grasses for hay and pasture but poorly suited to deep rooted legumes such as alfalfa because of wetness and a high water table in spring. If this soil is used for pasture, the major concerns of management are overgrazing and grazing when the soil is wet. Grazing when the soil is wet causes surface compaction and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, and a few small areas remain in native hardwoods. Most wooded areas are grazed. Seedings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling.

This soil has severe limitations for building sites and for septic tank absorption fields. A seasonal high water table is the main limitation. An adequate drainage system and storm sewers are needed to lower the water table. Dwellings and small buildings should be constructed without basements, and foundations and footings should be designed to prevent structural damage caused by low strength. Limitations for local streets and roads are severe because of frost action and low strength. The base can be strengthened with suitable material. Excess water can be removed by ditches. The absorption field for septic tank systems should be enlarged on drained areas of this soil because permeability is restricted.

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

Bc—Blount silt loam, 0 to 2 percent slopes. This soil is nearly level, deep, and somewhat poorly drained. It is on slight convex rises in the broad, gently undulating upland till plains. Areas are irregularly shaped and range from 3 to 100 acres in size.

In a typical profile the surface layer is dark grayish brown silt loam about 9 inches thick. The subsoil is mottled, firm clay loam about 36 inches thick. The upper part is yellowish brown, the middle part is brown, and the lower part is grayish brown. The underlying material, to a depth of 60 inches, is light olive brown, mottled, firm clay loam. In many areas the silt mantle is more than 18 inches thick. The silt mantle is very thin in the southern part of the county and is thicker toward the Wabash River. In small areas the soil is underlain by loam glacial till.

Included with this soil in mapping are many small depressional areas of very poorly drained Pewamo soils. A few of these areas are along minor drainageways. Also included are a few narrow areas of moderately well drained, gently sloping Morley soils on knolls and along the sides of small drainageways. These soils dry out more quickly in spring than the Blount soil.

Available water capacity is high, and permeability is slow or moderately slow. The organic matter content of the surface layer is moderate. Surface runoff is slow. The water table is at a depth of 1 to 3 feet in winter and spring and restricts the depth to which plant roots penetrate.

Most of the acreage of this soil is farmed. Most areas are used for corn and soybeans. A few areas are used for forage grasses and legumes, tomatoes, small grain, and woodland. If drained, this soil has good potential for crops. It has poor potential for sanitary facilities and building sites.

This soil is well suited to corn, soybeans, and small grain. Wetness and slow or moderately slow permeability are the major limitations. If the soil is adequately drained, row crops can be grown most of the time. Minimum tillage, using crop residue, and growing cover crops help to maintain and improve organic matter content and maintain good tilth.

This soil is well suited to grasses for hay and pasture but poorly suited to deep rooted legumes such as alfalfa because of wetness and a high water table in winter and spring. If this soil is used for pasture, the major concerns of management are overgrazing and grazing when the soil is wet. Grazing when the soil is wet causes surface compaction and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to trees, and a few small areas remain in native hardwoods. Most wooded areas are grazed. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling.

This soil has severe limitations for building sites and for septic tank absorption fields. A seasonal high water table is the main limitation. An adequate drainage system and storm sewers are needed to lower the water table. Dwellings and small buildings should be constructed without basements, and foundations and footings should be designed to prevent structural damage caused by low strength. Foundation drains are needed to remove excess water. Limitations for local streets and roads are severe because of frost action and low strength. The base can be strengthened with suitable material. Excess water can be removed by ditches. The absorption field for septic tank systems can be used only on drained areas, but the field should be enlarged because permeability is restricted.

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

Br—Brookston loam. This soil is nearly level, deep, and very poorly drained. It is in slight depressions on broad, slightly undulating till plains. It is frequently ponded by runoff from adjacent higher lying areas. Areas are generally irregularly shaped and range from 3 to 300 acres in size.

In a typical profile the surface layer is very dark gray loam about 10 inches thick. The subsurface layer is very dark grayish brown loam about 2 inches thick. The subsoil is mottled, firm clay loam about 37 inches thick. The upper part of the subsoil is gray, and the lower part is yellowish brown. The underlying material, to a depth of 60 inches, is calcareous, yellowish brown, mottled, friable loam. In some areas the dark colored surface layer is less than 10 inches thick.

Included with this soil in mapping are many, small, irregularly shaped areas and narrow strips of somewhat poorly drained Aubbeenaubbee and Crosier soils on slight rises. A few narrow areas along the sides of small drainageways or small mounds of well drained Wawasee and Metea soils are also included. These soils dry out more quickly in spring than the Brookston soil. A few narrow areas of Houghton, Palms, and Rensselaer soils are in slightly deeper depressions.

Available water capacity is high, and permeability is moderate. The organic matter content of the surface layer is high. Surface water runoff is very slow. The water table is between the surface and a depth of 1 foot in winter and spring and restricts the depth to which plant roots penetrate. Clods form if this soil is plowed when wet. Clods are difficult to break down into a friable seedbed.

Most of the acreage of this soil is farmed. Most areas are used for corn and soybeans. A few areas are used for hay, pasture, and woodland. If adequately drained, the soil has good potential for crops. It has poor potential for sanitary facilities and building sites.

This soil is well suited to corn and soybeans. Wetness is the main limitation in use and management of this soil. If this soil is adequately drained, row crops can be grown most of the time. Minimum tillage, using crop residue, and growing cover crops help to maintain and improve organic matter content and maintain good tilth.

This soil is generally well suited to grasses and legumes for hay or pasture. It is poorly suited to deep rooted legumes because a high water table restricts the downward movement of roots and air. If this soil is used for pasture, the major concerns of management are grazing when the soil is too wet and overgrazing. Grazing when the soil is wet causes surface compaction and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to trees, but only a few areas are in woodland. Most wooded areas are grazed. This soil has a prolonged seasonal high water table that delays harvest. Trees that tolerate wet conditions are favored in stands. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling.

This soil has severe limitations for building sites and for septic tank absorption fields because it is wet and subject to brief flooding. Dwellings and small buildings should be constructed without basements, and foundations and footings should be designed to prevent structural damage caused by low strength. Local roads and streets are also limited by wetness and brief flooding. The high water table of this soil can be lowered and the frequency and duration of flooding reduced by an adequate drainage system. A central sewage system and storm sewers are usually needed. The base for local roads can be strengthened with more suitable material. Frost action is reduced when excess water is removed by road ditches.

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

ChB—Chelsea fine sand, 2 to 9 percent slopes. This soil is nearly level and gently sloping, and excessively drained. It is on outwash terraces and glacial till plains and moraines. This soil is on convex elongated ridges 5 to 20 feet high, 100 to 500 feet wide, and 300 feet to about 1/4 mile long. Slope is dominantly about 4 percent. Areas range from 3 to 60 acres in size.

In a typical profile the surface layer is dark grayish brown fine sand about 8 inches thick. The subsurface layer is yellowish brown, loose fine sand 28 inches thick. The next layer, to a depth of 60 inches, is yellowish brown, loose fine sand with bands of strong brown, very friable loamy fine sand 1/4 to 3/4 inch thick. In places the surface layer is loamy fine sand.

Included with this soil in mapping are small areas of well drained Metea and Wawasee soils and somewhat poorly drained Aubbeenaubbee and Crosier soils near the base of sand ridges on the uplands. These soils have more clay in the subsoil than the Chelsea soil and are underlain by loamy glacial till. They dry out more slowly in the spring and have more water available for crop growth in summer. Also included are areas of well drained Oshtemo and Ormas soils on terraces. These soils have more clay in the subsoil and are less droughty.

Available water capacity is low, and permeability is rapid. Organic matter content of the surface layer is low. Surface runoff is slow. The surface layer is very friable and easily tilled throughout a wide range of moisture content.

Most of the acreage of this soil is used for grasses and legumes for forage. Some areas are in woodland. Most wooded areas have been grazed. A few areas are used for corn, soybeans, and small grain. This soil has poor potential for crops and for hay and pasture. It has good potential for sanitary facilities and building sites.

This soil is poorly suited to corn, soybeans, or small grain because droughtiness is a severe limitation. Low natural fertility, low available water capacity, and soil blowing (fig. 6) are also limitations in the use and management of this soil. Blowing sand grains often cover up or cut off small plant seedlings. Conservation practices that control soil blowing and improve organic matter content are needed. Grasses and legumes reduce wind erosion. Minimum tillage, using crop residue, and growing cover crops and green manure crops help to control wind erosion and improve organic matter content of this soil.

This soil is poorly suited to grasses and legumes because of low natural fertility and low available water capacity. Legumes such as alfalfa help to control wind erosion. Overgrazing is a major concern. Stocking at proper rates, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil is suited to trees, but only a few areas remain in woodland. Most wooded areas have been grazed. The main limitation for woodland is seedling mortality. Unwanted trees and shrubs can be controlled or removed by spraying, cutting, or girdling. Woodland management also includes excluding livestock, harvesting mature trees, and saving desired seed trees.

This soil has only slight limitations for building sites. Cutbanks cave readily in shallow excavations. This soil has only slight limitations for septic tank absorption fields. There is a hazard of polluting the underground water supply.

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

Cr—Crosier loam, 0 to 2 percent slopes. This soil is nearly level, deep, and somewhat poorly drained. It is on slight convex rises in the broad, gently undulating upland till plains. Areas are irregularly shaped and range from 3 to 100 acres in size.

In a typical profile the surface layer is dark grayish brown loam about 10 inches thick. The subsurface layer is light brownish gray loam about 2 inches thick. The subsoil is about 21 inches thick. The upper part is yellowish brown, mottled, firm clay loam, and the lower part is brown, mottled, firm clay loam. The underlying material, to a depth of 60 inches, is calcareous, grayish brown, mottled, friable loam. In some steeper areas the upper part of the subsoil is less mottled.

Included with this soil in mapping are many small areas of very poorly drained Brookston soils in shallow depressions and narrow drainageways and areas of somewhat poorly drained Aubbeenaubbee soil. A few areas of well drained, gently sloping Metea and Wawasee soils on small knolls and along the sides of small drainageways are also included. These soils dry out more quickly in spring and often lack sufficient soil moisture for crop growth during summer. Also included are some small spots of soil that have a loamy sand surface layer.

Available water capacity is high, and permeability is moderately slow. The organic matter content of the surface layer is moderate. Surface runoff is slow. The water table is at a depth of 1 to 3 feet in winter and spring.

Most of the acreage of this soil is farmed. Most areas are used for corn and soybeans. A few areas are used for forage grasses and legumes, small grain, and small woodlots. If drained, this soil has good potential for crops. It has poor potential for sanitary facilities and building sites.

This soil is well suited to corn, soybeans, and small grains. Wetness and moderately slow permeability are the main limitations. If this soil is adequately drained, row crops can be grown most of the time. Minimum tillage, using crop residue, and growing cover crops help to maintain and improve organic matter content and maintain good tilth.

This soil is well suited to grasses for hay and pasture but poorly suited to deep rooted legumes such as alfalfa because of wetness and a high water table in spring. If this soil is used for pasture, the major concerns of management are overgrazing and grazing when the soil is wet. Grazing when the soil is wet causes surface compaction and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to trees, and a few small areas remain in native hardwoods. Most wooded areas are grazed. Woodland is moderately limited by plant competition. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling.

This soil has severe limitations for building sites because of a seasonal high water table. An adequate drainage system and storm sewers are needed to lower the water table. Dwellings and small buildings should be constructed without basements, and foundations and footings should be designed to prevent structural damage caused by low strength and shrinking and swelling. Limitations for local streets and roads are severe because of frost action and low strength. The base can be strengthened with suitable material. Excess water can be removed by ditches. This soil has severe limitations for septic tank absorption fields because of a seasonal high water table and moderately slow permeability.

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

Fn—Fincastle silt loam, 0 to 2 percent slopes. This soil is nearly level, deep, and somewhat poorly drained. It is on slight convex rises on broad, gently undulating upland till plains. Areas are irregularly shaped and range from 3 to 100 acres in size.

In a typical profile the surface layer is dark grayish brown silt loam about 9 inches thick. The subsurface layer is pale brown silt loam about 2 inches thick. The subsoil is about 35 inches thick. The upper part is yellowish brown, mottled, firm silty clay loam; the next part is yellowish brown, mottled, firm clay loam; and the lower part is yellowish brown, mottled, friable loam. The underlying material, to a depth of 60 inches, is calcareous, grayish brown, friable loam. In many areas the silt mantle is less than 18 inches thick. In some steeper areas, the upper part of the subsoil is less mottled and the surface layer is brown or dark brown.

Included with this soil in mapping are many areas of very poorly drained Treaty soils in small shallow depressions and narrow drainageways. These soils dry out more slowly in spring than the Fincastle soil. Also included are a few areas of well drained, gently sloping Miami soils on small knolls and along the sides of small drainageways. These soils dry out more rapidly in spring.

Available water capacity is high, and permeability is moderately slow. The organic matter content of the surface layer is moderate. Surface runoff is slow. The water table is at a depth of 1 to 3 feet in winter and spring.

Most of the acreage of this soil is farmed. Most areas are used for corn and soybeans. A few areas are used for forage grasses and legumes, small grain, and woodland. If drained, this soil has good potential for crops. It has poor potential for sanitary facilities and building sites.

This soil is suited to corn, soybeans, and small grain. Wetness and moderately slow permeability are the major concerns in use and management. If this soil is adequately drained, row crops can be grown most of the time. Minimum tillage, using crop residue, and growing cover crops help to maintain and improve organic matter content and maintain good tilth.

This soil is well suited to grasses for hay and pasture but poorly suited to deep rooted legumes such as alfalfa because of wetness and a high water table in spring. If this soil is used for pasture, the major concerns of management are overgrazing and grazing when the soil is wet. Grazing when the soil is wet causes surface compaction and poor tilth. Stocking at proper rates, pasture rotations, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to trees, and a few areas remain in native hardwoods. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling.

This soil has severe limitations for building sites because of a seasonal high water table. An adequate drainage system and storm sewers are needed to lower the water table. Dwellings and small buildings should be constructed without basements, and foundations and footings should be designed to prevent structural damage caused by low strength and shrinking and swelling. Limitations for local roads and streets are severe because of wetness, frost action, and low strength. The base can be strengthened with suitable material. Excess water can be removed by ditches. This soil has severe limitations for septic tank absorption fields because of a seasonal high water table and moderately slow permeability.

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

FsA—Fox silt loam, 0 to 2 percent slopes. This soil is nearly level, moderately deep to sand and gravel, and well drained. It is on broad outwash terraces along the valleys of major streams. Slope is dominantly about 1 percent. Most areas are irregularly shaped, and some are elongated. They range from 4 to 300 acres in size.

In a typical profile the surface layer is dark grayish brown silt loam about 9 inches thick. The subsoil is about 30 inches thick. The upper part is brown, friable and firm silt loam and clay loam; the lower part is brown and very dark grayish brown, firm gravelly clay loam. The underlying material, to a depth of 60 inches, is brown, loose, stratified gravelly sand and sand. In some areas the silt mantle is thinner, and in other areas the surface layer is sandy loam. In some areas the subsoil is thicker and the soil is deeper to calcareous gravelly sand and sand. In places the subsoil has more gravel.

Included with this soil in mapping are many areas of Oshtemo sandy loam. This soil dries out sooner in spring than the Fox soil and by late summer often lacks sufficient moisture for crop growth. Also included are narrow areas of somewhat poorly drained Sleeth soils at slightly lower elevation. In a few areas slope is more than 2 percent.

Available water capacity is moderate. Permeability is moderate in the subsoil and very rapid in the substratum. The organic matter content is moderate. Surface runoff is slow. The surface layer is friable and easily tilled throughout a wide range of moisture content.

Most of the acreage of this soil is farmed. Most areas are used for corn, soybeans, and small grain. A few areas are used for forage grasses and legumes and woodland. This soil has good potential for crops and for hay and pasture. It has good potential for most sanitary facilities and building sites.

This soil is well suited to corn, soybeans, and small grain. Droughtiness is a moderate limitation in using this soil for corn and soybeans. With irrigation and proper management, this soil is suited to intensive row cropping. Minimum tillage, growing winter cover crops, and using crop residue help to maintain and improve organic matter content and maintain good tilth.

This soil is well suited to grasses and legumes for forage. If this soil is used for hay or pasture, the major concerns of management are a slight limitation of droughtiness in late summer, overgrazing, and grazing when the soil is wet. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, but only a few areas remain in woodland. Most wooded areas have been grazed. The main limitation for woodland use is plant competition. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling. Woodland management also includes excluding livestock, harvesting mature trees, and saving desired seed trees.

This soil has moderate limitations for building sites. Cutbank caving is a severe limitation in shallow excavations. Foundations, footings, and basement walls should be properly designed to prevent structural damage caused by low strength and shrinking and swelling. This soil has only slight limitations for septic tank absorption fields, but there is a hazard of polluting the underground water supply. The base for local roads and streets can be strengthened with more suitable material.

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

FsB—Fox silt loam, 2 to 6 percent slopes. This soil is gently sloping, moderately deep over sand and gravelly sand, and well drained. It is on broad outwash terraces along the valleys of major streams. Slope is dominantly about 4 percent. Most areas are elongated, and some are irregularly shaped. They range from 4 to 50 acres in size.

In a typical profile the surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil is about 28 inches thick. The upper part is brown, firm silty clay loam and clay loam, and the lower part is very dark gray, firm gravelly clay loam. The underlying material, to a depth of 60 inches, is brown, loose, stratified gravelly sand and sand. In some areas the surface layer is sandy loam. In some areas the subsoil is thicker and the soil is deeper to calcareous gravelly sand and sand. In some areas the subsoil has more sand or more gravel.

Included with this soil in mapping are narrow areas of Oshtemo sandy loam. This soil dries out sooner in spring and by summer often lacks sufficient moisture for crop growth. In a few areas slope is less than 2 percent.

Available water capacity is moderate. Permeability is moderate in the subsoil and very rapid in the substratum. The organic matter content is moderate. Surface runoff is medium. The surface layer is friable and easily tilled throughout a wide range of moisture content.

Most of the acreage of this soil is farmed. It is used for corn, soybeans, and small grain. A few areas are used for forage grasses and legumes and for woodland. This soil has good potential for crops and for hay and pasture. It has good potential for most sanitary facilities and building sites.

This soil is suited to corn and soybeans and well suited to small grain. Erosion is the main hazard and droughtiness is a limitation in using this soil for corn and soybeans. If the soil is cultivated, conservation practices are needed to control erosion and surface runoff. Minimum tillage, crop rotation, growing winter cover crops, and using crop residue help to reduce runoff and erosion and improve and maintain tilth and organic matter content of this soil.

This soil is well suited to grasses and legumes for hay and pasture. Hay and pasture are effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, but only a few areas remain in woodland. Most wooded areas have been grazed. The main limitation for woodland use is plant competition. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling. Woodland management also includes excluding livestock, harvesting mature trees, and saving desired seed trees.

This soil has moderate limitations for building sites. Cutbank caving is a severe limitation in shallow excavations. Foundations, footings, and basement walls should be properly designed to prevent structural damage caused by low strength and shrinking and swelling. This soil has only slight limitations for septic tank absorption fields, but there is a hazard of polluting the underground water supply. The base for local roads and streets can be strengthened with more suitable material.

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

FzC3—Fox clay loam, 8 to 15 percent slopes, severely eroded. This soil is moderately sloping, moderately deep over sand and gravelly sand, and well drained. It is on broad outwash terraces along the valleys of major streams. Most areas are elongated, and some are irregularly shaped. They range from 4 to 20 acres in size.

In a typical profile the surface layer is brown clay loam about 6 inches thick. The subsoil is about 24 inches thick. The upper part is brown, firm clay loam, and the lower part is brown, firm gravelly clay loam. The underlying material, to a depth of 60 inches, is brown, stratified gravel and sand. In small areas the surface layer is dark grayish brown silt loam that is friable and easy to plow and the soil is deeper to calcareous gravel and sand. In other areas the subsoil is thinner and the soil is less deep to calcareous gravel and sand.

Included with this soil in mapping are narrow areas of Oshtemo sandy loam, a few small areas of Fox silt loam and Oshtemo sandy loam that have slope of less than 6 percent, and narrow areas of Fox clay loam that has slope of more than 15 percent.

Available water capacity is low. Permeability is moderate in the subsoil and rapid in the underlying material. The organic matter content is moderate. Surface water runoff is rapid. This soil is difficult to plow, and clods form if the soil is plowed when wet. The clods are difficult to break down into a suitable seedbed.

Most of the acreage of this soil is used for pasture. Some areas are used for corn, soybeans, and small grain. A few areas are used for upland wildlife habitat. This soil has poor potential for crops and fair potential for sanitary facilities and building sites. It has fair potential for hay or pasture.

This soil is poorly suited to corn, soybeans, and small grains. There is a severe hazard of further erosion damage. Droughtiness is a limitation in using this soil for cultivated crops. If this soil is cultivated, extensive conservation practices are needed to control erosion and surface runoff. A combination of such practices as minimum tillage, diversions, contour farming, grassed waterways, or grade stabilization structures prevents excessive soil loss. Using crop residue and growing cover crops and green manure crops help to control erosion and improve and maintain organic matter content of this soil. Growing grasses and legumes for forage most of the time reduces runoff and helps to control erosion.

This soil is well suited to grasses and legumes for hay and pasture. Hay and pasture are effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, but very few areas remain in woodland. Most wooded areas have been grazed. The main limitation for woodland use is plant competition. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling. Woodland management also includes excluding livestock, harvesting mature trees, and saving desired seed trees.

This soil has moderate limitations for building sites because of slope, shrinking and swelling, and low strength. Cutbank caving is a severe limitation in shallow excavations. Foundations, footings, and basement walls should be properly designed to prevent structural damage caused by low strength and shrinking and swelling. Grading or cutting and filling to modify slope or designing the project to complement the slope compensates for slope. Limitations for septic tank absorption fields are moderate because of slope, but the absorption field can be designed to operate properly. The base for local streets and roads can be strengthened with suitable material.

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

Ge—Gessie silt loam. This soil is nearly level, deep, and well drained. It is on flood plains of large streams. This soil is subject to rare flooding. Areas are irregularly shaped or elongated and extend for long distances on the bottom lands. They range from 5 to 250 acres in size.

In a typical profile the surface layer is dark grayish brown silt loam about 10 inches thick. The underlying material, to a depth of about 60 inches, is brown and yellowish brown, friable silt loam. In small areas the surface layer is silty clay loam. In small areas mottles are between depths of 20 and 30 inches. In a few areas on the large flood plains the surface layer is very dark grayish brown.

Included with this soil in mapping are a few, small, elongated areas of Stonelick soils, mainly along the natural levees of the larger streams. Also included are small, narrow areas of poorly drained Shoals and Sloan soils in shallow depressions and small drainageways.

Available water capacity is high, and permeability is moderate. Organic matter content of the surface layer is moderate. Surface runoff is slow. The surface layer is friable and easily tilled throughout a fairly wide range in moisture content.

Almost all of the acreage of this soil is used intensively for corn and soybeans. A few areas are used for small grain. Grasses and legumes for hay and pasture and trees are grown on the narrow flood plains of minor stream valleys. This soil has good potential for crops and poor potential for sanitary facilities and building sites.

This soil is well suited to corn and soybeans on the large flood plains. It has few limitations for crops. Late planting or replanting is sometimes necessary because of rare flooding in spring. Large flood control dams reduce the frequency and severity of flooding. Row crops can be grown most of the time. Minimum tillage, growing winter cover crops, and using crop residue help to maintain and improve organic matter content and maintain good tilth.

This soil is well suited to grasses and legumes for hay or pasture. It is slightly limited by rare flooding. If this soil is used for pasture, the major concerns of management are overgrazing and grazing when the soil is wet. Grazing when the soil is wet causes surface compaction and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, and a few small areas remain in native hardwoods. Most wooded areas are grazed. Plant competition is the main limitation. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling.

This soil has severe limitations for building sites because of flooding and is generally unsuitable for this use. It has moderate limitations for local roads and streets because of rare flooding, low strength, and moderate potential frost action. The base can be strengthened with more suitable material. Limitations for septic tank absorption fields are moderate because of rare flooding and the restricted permeability.

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

Gr—Gilford sandy loam. This soil is nearly level, deep, and very poorly drained. It is on outwash terraces, around organic soils, and in some small stream valleys. This soil is frequently ponded by runoff from adjacent higher lying areas. Most areas are elongated, and some are irregular. They range from 3 to 30 acres in size.

In a typical profile the surface layer is very dark gray sandy loam about 20 inches thick. The subsoil is about 19 inches thick. The upper part is gray, mottled, friable clay loam, and the lower part is gray, very friable sandy loam. The underlying material, to a depth of 60 inches, is gray, stratified sand, sandy loam, silt loam, and loam. In some areas the dark colored surface layer is less than 10 inches thick. In many areas the subsoil has more clay. In some small areas the soil is underlain by loam or silty clay loam glacial till.

Included with this soil in mapping are narrow areas of Brookston and Pewamo soils. These soils are slightly higher in elevation, are more difficult to plow, are less likely to pond, and dry out a little sooner in spring than the Gilford soil. Also included are small spots and narrow areas of Palms and Houghton muck. These are slightly lower in elevation, are more likely to pond, and dry out more slowly in spring; plowing is often delayed. Also included are a few small areas, around large depressions, of very poorly drained soils that are sandy throughout and a few areas of soils that stay wet for long periods.

Available water capacity is moderate, and permeability is moderately rapid. The organic matter content of the surface layer is high. Surface runoff is very slow. The water table is between the surface and a depth of 1 foot in winter and spring and restricts the depth to which plant roots penetrate.

Most of the acreage of this soil is farmed. Most areas are used for corn and soybeans. A few areas are used for hay, pasture, and woodland. If adequately drained, this soil has good potential for crops. It has poor potential for sanitary facilities and building sites.

This soil is well suited to corn and soybeans. Wetness is the main limitation in use and management of this soil. If the soil is adequately drained, row crops can be grown most of the time. Minimum tillage, using crop residue, and growing cover crops help to maintain and improve organic matter content and maintain good tilth.

This soil is generally well suited to grasses and legumes for hay or pasture. It is poorly suited to deep rooted legumes because a high water table restricts downward movement of roots and water. If this soil is used for pasture, the major concerns of management are grazing when the soil is too wet and overgrazing. Grazing when the soil is wet causes surface compaction and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to trees, but only a few areas are in woodland. Most wooded areas are grazed. This soil has a prolonged seasonal high water table that delays harvest. Trees that tolerate wet conditions are favored in stands. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling.

This soil has severe limitations for building sites and for septic tank absorption fields because it is wet and subject to brief flooding. Dwellings and small buildings should be constructed without basements. The high water table of this soil can be lowered and the frequency and duration of flooding reduced by an adequate drainage system. A central sewage system and storm sewers are usually needed. Local roads and streets are also subject to wetness and brief flooding. Excess water can be removed by drainage ditches.

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

HeG—Hennepin silt loam, 25 to 50 percent slopes. This soil is steep and very steep, deep, and well drained. It formed in calcareous glacial till on uplands. This soil is on long, narrow side slopes between the flood plains and the uplands and on the sides of V-shaped valleys on the till plains. Slope is dominantly more than 35 percent. Areas range from 5 to 200 acres in size.

In a typical profile the surface layer is dark grayish brown silt loam about 3 inches thick. The subsoil is brown, friable loam about 9 inches thick. The underlying material, to a depth of 60 inches, is pale brown loam. In most areas the depth to calcareous underlying material varies within short distances, and in many spots the soil is calcareous at a depth of more than 20 inches.

Included with this soil in mapping are some narrow areas of Morley soils, normally on the upper parts of side slopes. These soils have a thicker subsoil and are less sloping than the Hennepin soil. Also included are some areas of soils that have a gravelly substratum, generally along the Wabash River valley sides and on the upper parts of side slopes associated with Fox and Ockley soils. Also included are some escarpments.

Available water capacity is high. Permeability is moderate in the subsoil and moderately slow in the underlying till. The organic matter content of the surface layer is high. Surface runoff is very rapid.

Most of the acreage of this soil is used for woodland. A few areas are used for pasture. This soil has poor potential for crops, sanitary facilities, building sites, or pasture.

This soil is not suited to cultivated crops because of the severe hazard of erosion and because the steep slopes prevent the use of farm machinery.

This soil is generally unsuited to grasses and legumes for forage because of the severe hazard of erosion and the steep slopes, which prevent the use of farm machinery.

This soil is well suited to trees, and this is the dominant use (fig. 7). Many wooded areas are grazed. The limitations on the use of equipment and the erosion hazard are severe because of the steep slope. Plant competition is moderate. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, and girdling. Woodland management should also include excluding livestock, harvesting mature trees, and saving desired seed trees.

This soil has severe limitations for building sites, septic tank absorption fields, and local roads and streets because of steep and very steep slopes. The slope is such a severe limitation and so difficult to overcome that selecting another site may be the best option.

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

Hx—Houghton muck, drained. This soil is nearly level, deep, and very poorly drained. It is in deep depressions on moraines, till plains, outwash plains, or alluvial plains that were formerly shallow lakes or marshes. It is frequently ponded by runoff from adjacent higher lying areas. Most areas in the small depressions are irregularly shaped to circular and 3 to 40 acres in size. The larger areas are mainly irregularly shaped or oval.

In a typical profile the surface layer is black, friable muck about 12 inches thick. The next layer is very dark grayish brown, very friable muck that contains small amounts of peat. The lower layer of organic material, to a depth of 60 inches, is dark brown, very friable muck that contains many partially decomposed fibrous and few woody peat fragments. In some places the organic material is less than 60 inches thick. Also, the degree of decomposition and type of organic material are variable.

Included with this soil in mapping are many small scattered areas of soils that have less than 40 inches of muck over marl or mineral material. Also included are small elongated or irregularly shaped areas of soils that have 20 to 24 inches of dark grayish brown silt loam organic material. The silt loam was eroded from sloping mineral soils or outwash deposits in drainageways and deposited on the organic soil. Also included around the edges of mapped areas are narrow areas of Brookston, Pewamo, Rensselaer, and Washtenaw soils. These soils dry out sooner in spring and are less likely to flood during the growing season than the Houghton soil. Many areas in the northern third of the county are not drained or have drainage that is not adequate for crop production.

Available water capacity is very high, and permeability is moderately rapid. Organic matter content of the surface layer is very high. Surface runoff is very slow. The surface layer is friable and easily tilled; however, because of very slow runoff, the high water table, and ponding of water from adjacent higher ground, this soil often remains wet late in spring.

Most of the acreage of this soil is farmed. Corn is the main crop. Small areas are used for soybeans, small grain, and grasses for hay or pasture. If adequately drained, this soil has good potential for cultivated crops and grasses for hay or pasture. Undrained areas provide wetland wildlife habitat. Potential for woodland, sanitary facilities, and building sites is poor.

This soil is well suited to corn. Wetness is the major limitation. Wind erosion is a hazard in large areas that have been drained and cultivated. Artificial drainage is necessary for crops. Tile, open ditch, and pump drainage, individually or in combination, are common. Diversions also help in controlling wetness. Minimum tillage, tilling at the proper moisture content, and various types of windbreaks reduce wind erosion and increase water infiltration.

This soil is suited to grasses and legumes for hay or pasture, but it is poorly suited to deep rooted legumes such as alfalfa because of the water table, which restricts root growth, and frost heaving. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is very poorly suited to trees. A few small areas remain in native hardwoods and shrubs and are used mainly for wildlife habitat. Planting and harvesting are severely limited. Only water-tolerant trees survive and grow on this soil even if it is drained.

This soil has severe limitations for building sites, septic tank absorption fields, and local roads and streets. It is poorly suited to most nonagricultural uses because it is wet, is subject to flooding, and has low strength and high frost action potential. The soil features are such severe limitations and so difficult to overcome that selecting another site may be the best option.

This soil is in capability subclass IIIw and woodland suitability subclass 3w.

MaA—Martinsville sandy loam, 0 to 2 percent slopes. This soil is nearly level, deep, and well drained. It is on broad outwash terraces. Most areas are irregularly shaped and range from 5 to 500 acres in size.

In a typical profile the surface layer is dark grayish brown sandy loam about 9 inches thick. The subsoil is about 32 inches thick. The upper part is dark brown, friable loam; the next part is brown, friable clay loam; the next part is dark yellowish brown, firm clay loam; and the lower part is brown, very friable sandy loam. The underlying material, to a depth of 88 inches, is stratified, dark yellowish brown silty clay loam, silt loam, or loam. In some areas stratified gravel and sand is in the underlying material.

Included with this soil in mapping are areas of well drained Metea and Wawasee sandy loam on slightly elevated knolls and irregularly shaped ridges. A few small areas of Oshtemo soils are also included. The Metea and Oshtemo soils dry out more quickly in spring and by late summer often lack sufficient soil moisture for optimum crop growth. A few narrow areas along drainageways have slopes of more than 2 percent.

Available water capacity is high, and permeability is moderate. The organic matter content is moderate. Surface runoff is slow. The surface layer is very friable and easily tilled throughout a wide range of moisture content.

Most of the acreage of this soil is farmed. Most areas are used for corn, soybeans, or grasses and legumes for forage. A few areas are used for woodland. This soil has good potential for crops, for hay and pasture, and for sanitary facilities and building sites.

This soil is well suited to corn, soybeans, and small grain. It has few limitations for crops. Droughtiness in late summer is a slight limitation. Minimum tillage, growing winter cover crops, and using crop residue help to maintain and improve organic matter content and maintain good tilth.

This soil is well suited to grasses and legumes for forage. If this soil is used for hay or pasture, the major concerns of management are a slight limitation of droughtiness in late summer, overgrazing, and grazing when the soil is wet. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, but only a few areas remain in woodland. Most wooded areas have been grazed. The main limitation for woodland use is plant competition. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling. Woodland management also includes excluding livestock, harvesting mature trees, and saving desired seed trees.

This soil has moderate limitations for building sites. Foundations, footings, and basement walls should be properly designed to prevent structural damage caused by low strength and shrinking and swelling. This soil has slight limitations for septic tank absorption fields, but there is a hazard of polluting the underground water supply. The base for local roads and streets can be strengthened with more suitable material.

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

MeB—Metea loamy fine sand, 2 to 6 percent slopes. This soil is gently sloping, deep, and well drained. It formed in wind-blown loamy sand and underlying glacial till. This soil is on caplike knolls, ridges, and some side slopes on undulating upland till plains and moraines. The slopes are short. Slope is dominantly about 4 percent. Most areas are irregularly shaped, but many are circular. They range from 4 to 30 acres in size.

In a typical profile the surface layer is dark grayish brown loamy fine sand about 10 inches thick. The subsoil is about 34 inches thick. The upper part is light yellowish brown and yellowish brown, very friable loamy fine sand, and the lower part is yellowish brown, firm clay loam. The underlying material, to a depth of 60 inches, is light yellowish brown loam. In some areas the loamy fine sand is less than 18 inches thick. In some areas the subsoil is thicker and the soil is deeper to calcareous underlying glacial till. In many areas the surface layer is sandy loam.

Included with this soil in mapping are small areas of Aubbeenaubbee and Crosier soils in small flat areas, in minor drainageways, or at the base of some side slopes. They are somewhat poorly drained and dry out more slowly in spring than the Metea soil. Also included are areas of Wawasee and Morley sandy loams. These soils dry out more slowly in spring and generally have adequate soil moisture for crop growth during summer. Also included and intermingled throughout this unit are areas that have slopes of less than 2 percent or more than 6 percent.

Available water capacity is moderate. Permeability is moderate in the subsoil and moderately slow in the underlying material. Organic matter content of the surface layer is moderate. Surface runoff is slow. The surface layer is very friable and easily tilled throughout a wide range of moisture content.

Most of the acreage of this soil is farmed. Most areas are used for corn, soybeans, and small grain. Some areas are used for grasses and legumes for forage, and a few areas are used for woodland. This soil has fair potential for crops, for hay or pasture, and for sanitary facilities and building sites.

This soil is suited to corn, soybeans, and small grain. Erosion is the main hazard. Droughtiness, soil blowing, low natural fertility, and moderate available water capacity are also limitations in use and management of this soil. If the soil is cultivated, conservation practices are needed to control erosion and surface runoff. Blowing sand grains often cover up or cut off crop seedlings. Crop rotation, minimum tillage, contour farming, and grassed waterways help to prevent excessive erosion. Using crop residue and growing cover crops and green manure crops help to control erosion and improve and maintain tilth and organic matter content of this soil.

This soil is well suited to grasses and legumes for forage. Forage is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, but only a few areas remain in woodland. Most wooded areas have been grazed. The main limitation for woodland use is seedling mortality. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by spraying, cutting, or girdling. Woodland management also includes excluding livestock, harvesting mature trees, and saving desired seed trees.

This soil has moderate limitations for building sites. Foundations, footings, and basement walls should be properly designed to prevent structural damage caused by shrinking and swelling and low strength. This soil has severe limitations for septic tank absorption fields because of moderately slow permeability. Enlarging the filter field compensates for the reduced permeability. Lateral seepage on the top of the glacial till occurs in poorly designed systems, and the liquid can travel several feet before surfacing. The base for local roads and streets can be strengthened with more suitable material.

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

MhB—Miami silt loam, 2 to 6 percent slopes. This soil is gently sloping, deep, and well drained. It is on convex knolls and short, uneven sides of drainageways on the upland till plains. The slopes are short. Slope is dominantly about 4 percent. Most areas are irregularly shaped, but many are elongated. Areas range from 3 to 40 acres in size.

In a typical profile the surface layer is dark brown silt loam about 10 inches thick. The subsoil is about 24 inches thick. The upper part is dark yellowish brown, friable silt loam, and the lower part is dark yellowish brown, firm clay loam. The underlying material, to a depth of 60 inches, is yellowish brown loam. In some places the subsoil is thicker and the soil is deeper to calcareous loam. In some areas the upper part of the subsoil has been mixed with the surface soil by plowing and the plow layer is silty clay loam or clay loam. In more nearly level areas the lower part of the subsoil has mottles.

Included with this soil in mapping are small areas of Fincastle and Treaty soils in shallow depressions and minor drainageways. These soils are more poorly drained than the Miami soils and dry out more slowly in spring. Also included are some narrow areas along drainageways that have slopes of more than 6 percent.

Available water capacity is high. Permeability is moderate in the subsoil and moderately slow in the underlying till. The organic matter content of the surface layer is moderate. Surface runoff is medium. The surface layer is friable and easily tilled throughout a fairly wide range in moisture content. The surface tends to crust after heavy rains, especially where the plow layer contains subsoil material. Root development is somewhat restricted below a depth of 38 inches by the compacted glacial till.

Most of the acreage of this soil is farmed. Most areas are used for corn, soybeans, and small grain. Some areas are used for hay or pasture. A few areas are used for woodland. This soil has good potential for crops and fair potential for sanitary facilities and building sites.

This soil is well suited to corn, soybeans, and small grain. If the soil is cultivated, conservation practices are needed to control erosion and surface runoff. A combination of such practices as crop rotation, minimum tillage, diversions, contour farming, grassed waterways, or grade stabilization structures prevents excessive soil loss. Using crop residue and growing cover crops and green manure crops help to control erosion and improve and maintain tilth and organic matter content of this soil.

This soil is well suited to grasses and legumes for hay and pasture. Hay and pasture are effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, but only a few areas are in woodland. Most wooded areas are grazed. This soil is also moderately limited by plant competition. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling. Woodland management also includes excluding livestock, harvesting mature trees, and saving desired seed trees.

This soil has moderate limitations for building sites. Foundations, footings, and basement walls should be properly designed to prevent structural damage caused by shrinking and swelling and low strength. This soil has severe limitations for septic tank absorption fields because of the moderately slow permeability. Enlarging the filter field compensates for the reduced permeability. Lateral seepage on the top of the compacted till occurs in poorly designed systems, and the liquid can travel several feet before surfacing. The base for local roads and streets can be strengthened with more suitable material.

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

MhC3—Miami clay loam, 6 to 12 percent slopes, severely eroded. This soil is moderately sloping, deep, and well drained. It is on knolls and sides of moderately deep to deep drainageways in upland till plains and moraines. Slopes are short. Slope is dominantly 8 to 12 percent. Most areas are irregularly shaped, but many are elongated. They range from 3 to 40 acres in size.

In a typical profile the surface layer is brown clay loam about 6 inches thick. The subsoil is dark yellowish brown, firm clay loam about 20 inches thick. The underlying material, to a depth of 60 inches, is yellowish brown loam. In many small areas the surface layer is grayish brown silt loam that is friable and easy to plow and dries out sooner in the spring. In some small areas the underlying material has been mixed with the subsoil by plowing and the surface layer is yellowish brown, cloddy, calcareous clay loam. In most places the depth to underlying calcareous material varies within short distances and many spots are calcareous at a depth of less than 24 inches.

Included with this soil in mapping near the top or bottom of some slopes are a few narrow areas of less sloping and less eroded Miami soils. Also included are small areas that have slopes of more than 12 percent and a few narrow areas of steep and very steep Hennepin soils bordering major drainageways.

Available water capacity is high. Permeability is moderate in the subsoil and moderately slow in the underlying material. The organic matter content of the surface layer is moderate. Surface runoff is rapid. This soil is difficult to plow, and clods form if the soil is plowed when too wet. The clods are difficult to break down into a friable seedbed.

Most of the acreage of this soil is farmed. Many areas are used for corn, soybeans, and small grain. Some areas are used for hay and pasture. This soil has poor potential for crops. It has fair potential for sanitary facilities, building sites, and pasture or hay.

This soil is poorly suited to corn, soybeans, and small grain because of the very severe hazard of further erosion. If the soil is cultivated, extensive conservation practices are needed to control erosion and surface runoff. Minimum tillage, diversions, contour farming, grassed waterways, or grade stabilization structures help to prevent excessive soil loss. Using crop residue and growing cover crops and green manure crops help to control erosion and improve and maintain tilth and organic matter content of this soil. Growing grasses and legumes for hay and pasture most of the time is most effective in reducing runoff and controlling erosion.

This soil is well suited to grasses and legumes for hay and pasture. Hay and pasture are effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Stocking at proper rates, pasture renovation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, and a few areas are in small woodlots that are generally grazed. This use is moderately limited by plant competition. Seedlings survive and grow well if competing vegetation is controlled and livestock are excluded. Unwanted trees and shrubs can be removed by site preparation or by spraying, cutting, or girdling.

This soil has moderate limitations for building sites. Foundations, footings, and basement walls should be properly designed to prevent structural damage caused by shrinking and swelling and low strength. This soil has severe limitations for septic tank absorption fields because of the moderately slow permeability. Enlarging the filter field compensates for the reduced permeability. Lateral seepage on the top of the compacted till occurs in poorly designed systems, and the liquid can travel several feet before surfacing. The base for local roads and streets can be strengthened with more suitable material.

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

MhD3—Miami clay loam, 12 to 18 percent slopes, severely eroded. This soil is strongly sloping, deep, and well drained. It is on sides of deep drainageways in the upland till plains and moraines. Slopes are short. Slope is dominantly 14 to 18 percent. Most areas are irregularly shaped or elongated and range from 3 to 30 acres in size.

In a typical profile the surface layer is brown clay loam about 6 inches thick. The subsoil is dark yellowish brown, firm clay loam about 20 inches thick. The underlying material, to a depth of 60 inches, is yellowish brown loam. In some small areas the surface layer is grayish brown silt loam that is friable and easy to plow and dries out sooner in spring. There are also small areas where the underlying material has been mixed with the subsoil by plowing and the surface layer is grayish brown, cloddy, calcareous clay loam. In most places the depth to the calcareous underlying material varies within short distances and many spots are calcareous at a depth of less than 20 inches.

Included with this soil in mapping are a few narrow areas of steep and very steep Hennepin soils bordering major drainageways. Also included are small areas bordering major drainageways that have slopes of more than 18 percent and small areas near the top of slopes that have slopes of less than 12 percent.

Available water capacity is high. Permeability is moderate in the subsoil and moderately slow in the underlying till. The organic matter content of the surface layer is moderate. Surface runoff is very rapid. This soil is difficult to plow, and clods form if the soil is plowed when too wet. The clods are difficult to break down into a friable seedbed.

Most of the acreage of this soil is used for grasses and legumes for pasture or hay. Some areas are used for corn, soybeans, or small grain. This soil has poor potential for cultivated crops, sanitary facilities, and building sites. It has fair potential for pasture.

This soil is generally unsuitable for corn, soybeans, or small grain because of the very severe hazard of further erosion. Small grain is occasionally grown so that stands of grasses and legumes can be reestablished. Minimum tillage, diversions, grassed waterways, and using crop residue help to prevent excessive soil loss if this soil is used for crops. Growing grasses and legumes most of the time is most effective in reducing surface runoff and controlling erosion.

This soil is suited to grasses and legumes for hay and pasture. Hay and pasture are effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Stocking at proper rates, pasture renovation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, and a few areas are in small woodlots that are generally grazed. This soil is moderately limited by plant competition. Seedlings survive and grow well if competing vegetation is controlled and livestock are excluded. Unwanted trees and shrubs can be removed by site preparation or by spraying, cutting, or girdling.

This soil has severe limitations for building sites because of the steep slope. Design that complements the slope and cutting and filling compensate for the slope. Foundations, footings, and basement walls should be properly designed to prevent structural damage caused by shrinking and swelling and low strength. This soil has severe limitations for septic tank absorption fields because of the steep slope and moderately slow permeability. Designing lateral fields to function properly on the slope or installing a central sewage system overcomes the limitations. Enlarging the filter field compensates for the reduced permeability. Lateral seepage on the top of the compacted till occurs in poorly designed systems, and the liquid can travel several feet before surfacing. The base for local roads and streets can be strengthened with more suitable material.

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

Mk—Milford silty clay. This soil is nearly level, deep, and very poorly drained. It is in slight depressions on flood plains and old lakebeds. This soil is occasionally ponded with runoff from adjacent higher lying areas. Most areas are irregularly shaped and range from 6 to 90 acres in size.

In a typical profile the surface layer is very dark gray silty clay about 15 inches thick. The subsoil is gray, mottled, firm silty clay 30 inches thick. The underlying material, to a depth of about 60 inches, is gray, mottled silty clay loam.

Included with this soil in mapping are a few areas of very poorly drained Rensselaer and Sloan soils. Also included are a few small areas of Oshtemo soils on slight rises. These soils dry out more quickly in spring than the Milford soil.

Available water capacity is high, and permeability is moderately slow. The organic matter content of the surface layer is high. Surface runoff is very slow. The water table is between the surface and a depth of 1 foot in winter and spring and restricts the depth to which plant roots penetrate. Clods form if this soil is plowed when wet. Clods are difficult to break down into a friable seedbed.

Most of the acreage of this soil is farmed. Most areas are used for corn and soybeans. A few areas are used for hay, and small, irregularly shaped areas on narrow bottom land are used for pasture. If adequately drained, this soil has good potential for crops. It has poor potential for sanitary facilities and building sites.

This soil is well suited to corn and soybeans. Wetness is the main limitation. If the soil is adequately drained, row crops can be grown most of the time. Minimum tillage, using crop residues, and growing cover crops help to maintain and improve organic matter content and maintain good tilth.

This soil is well suited to grasses for hay and pasture but poorly suited to deep rooted legumes because of a high water table. The moderately slow permeability restricts downward movement of roots and water. If this soil is used for pasture, the major concerns of management are overgrazing and grazing when the soil is wet. Grazing when the soil is wet causes surface compaction and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, but only a few areas are in woodland. Most wooded areas have been grazed. This soil has a prolonged seasonal high water table that delays harvest. Trees that tolerate wetness are favored in stands. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling.

This soil has severe limitations for building sites because it is wet and subject to brief flooding. Dwellings and small buildings should be constructed without basements, and foundations and footings should be designed to prevent structural damage caused by low strength and shrinking and swelling. The high water table can be lowered and the frequency and duration of flooding reduced by an adequate drainage system. A central sewage system and storm sewers are usually needed. Local streets and roads are also subject to wetness and brief flooding. Strengthening the base with suitable material reduces frost action, and excess water can be removed by ditches.

This soil is in capability subclass IIw. Woodland suitability subclass not assigned.

Mm—Millsdale silty clay loam. This soil is nearly level, moderately deep, and very poorly drained. It is in slight depressions on limestone bedrock terraces. Areas are irregularly shaped and range from 5 to 120 acres in size.

In a typical profile the surface layer is black silty clay loam about 12 inches thick. The subsoil is gray and light gray, mottled, firm silty clay about 19 inches thick. The underlying material, to a depth of 60 inches, is limestone bedrock. In some areas the depth to limestone bedrock is less than 20 inches.

Included with this soil in mapping are a few areas of well drained Fox and Milton soils. Also included are a few narrow areas of very poorly drained Sebewa soils and somewhat poorly drained Shoals soils. These soils are slightly higher in elevation and dry out more quickly in spring than the Millsdale soil. Also included are small mounds of soils that are shallow and very shallow over bedrock, small areas of somewhat poorly drained soils that have a moderately dark colored surface layer, and a few stony areas.

Available water capacity is low, and permeability is moderately slow. The organic matter content of the surface layer is high. Surface runoff is very slow. Some areas are ponded. The water table is between the surface and a depth of 1 foot in winter and spring and restricts the depth to which plant roots penetrate. Clods form if this soil is plowed when wet. Clods are difficult to break down into a friable seedbed.

Most of the acreage of this soil is farmed. Most areas are used for corn and soybeans. Some areas are used for grasses and legumes for forage, and a few areas are in woodland. If adequately drained, this soil has moderate potential for crops. It has poor potential for sanitary facilities and building sites.

This soil is suited to corn and soybeans. Wetness is the main limitation. The moderate depth to bedrock, moderately slow permeability, and high water table are also limitations. Detailed site investigation for tile drainage systems is necessary because of the moderate depth to limestone bedrock. If the soil is adequately drained, row crops can be grown most of the time. Minimum tillage, plowing at the proper moisture content, using crop residue, and growing cover crops help to maintain and improve organic matter content and maintain good tilth.

This soil is well suited to grasses and legumes for forage but is poorly suited to deep rooted legumes because of a high water table, moderately slow permeability, and moderate depth to bedrock that restricts downward movement of roots and water. If this soil is used for pasture, the major concerns of management are overgrazing and grazing when the soil is wet. Grazing when the soil is wet causes surface compaction and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to trees, but only a few areas are in woodland. Most wooded areas are grazed. This soil has a prolonged seasonal high water table that delays harvest. Trees that tolerate wetness are favored in stands. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling.

This soil has severe limitations for building sites and septic tank absorption fields because it is wet, subject to brief flooding, and moderately deep to bedrock. Dwellings and small buildings should be constructed without basements. Foundations and footings should rest on solid bedrock to prevent structural damage caused by frost action and shrinking and swelling of this soil. The high water table can be lowered by extensive measures. The frequency and duration of flooding can be reduced by an adequate drainage system. A central sewage system and storm sewers are usually needed. Local streets and roads are also subject to wetness and brief flooding. Strengthening the base with suitable material reduces frost action, and excess water can be removed by ditches.

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

Mp—Milton silt loam, 0 to 2 percent slopes. This soil is nearly level, moderately deep, and well drained. It is on limestone bedrock terraces. Most areas are irregularly shaped, but many are elongated. They range from 4 to 50 acres in size.

In a typical profile the surface layer is dark grayish brown silt loam 8 inches thick. The subsoil is 24 inches thick. The upper part of the subsoil is dark yellowish brown, firm clay loam, and the lower part is dark yellowish brown, firm gravelly clay loam. The underlying material, to a depth of 60 inches, is light gray, fractured limestone bedrock. In some areas the depth to limestone bedrock is less than 20 inches. In some places there is very little gravel in the subsoil, but in some of these areas the soil has few to many, large to small pieces of weathered limestone.

Included with this soil in mapping are a few areas of very poorly drained Millsdale soils in slight depressions. Also included are a few areas of nearly level soils that have gray mottles in the subsoil and are moderately deep over limestone bedrock. These soils dry out more slowly in spring than the Milton soil. Also included are small areas that have slopes of more than 2 percent, generally along minor drainageways and at the base of steep or very steep slopes, and some areas with many stones, cobbles, and boulders on the surface.

Available water capacity is moderate, and permeability is moderate. The organic matter content of the surface layer is moderate. Surface runoff is slow. The surface layer is friable and easily tilled throughout a fairly wide range of moisture content. Limestone bedrock restricts root development below a depth of 32 inches.

Most of the acreage of this soil is farmed. Most areas are used for corn, soybeans, small grain, or grasses and legumes for forage. A few areas are used for woodland. Areas with many stones and boulders on the surface are well suited to grasses and legumes for pasture. These areas are suited to cultivated crops if the stones and boulders are removed. This soil has good potential for crops and for hay or pasture. It has poor potential for sanitary facilities and building sites.

This soil is suited to corn, soybeans, and small grain. It has few limitations for crops. Droughtiness in late summer is a limitation. Minimum tillage, growing winter cover crops, and using crop residue help to maintain and improve organic matter content and maintain good tilth.

This soil is well suited to grasses and legumes for forage. If this soil is used for hay or pasture, the major concerns of management are a slight limitation of droughtiness in late summer, overgrazing, and grazing when the soil is wet. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, but only a few areas remain in woodland. Most wooded areas have been grazed. The main limitation for woodland use is plant competition. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling. Woodland management also includes excluding livestock, harvesting mature trees, and saving desired seed trees.

This soil has moderate limitations for dwellings without basements because of the depth to bedrock and shrinking and swelling. For shallow excavations and dwellings with basements the limitations are more severe. Either bedrock must be removed or the structures must be designed according to the depth to bedrock. This soil also has severe limitations for septic tank absorption fields and for local roads and streets. Selecting another site or installing a central sewage system avoid the severe limitations for septic tank absorption fields. The base for local roads and streets can be strengthened with more suitable material.

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

MrB—Morley sandy loam, 2 to 6 percent slopes. This soil is gently sloping, deep, and moderately well drained. It is on undulating upland till plains and moraines. This soil is on knolls and side slopes around depressions and along drainageways. Most areas are irregularly shaped, but many are elongated. They range from 4 to 30 acres in size.

In a typical profile the surface layer is dark grayish brown sandy loam about 14 inches thick. The subsoil is about 28 inches thick. The upper part is dark yellowish brown, firm clay loam; the next part is yellowish brown, firm clay loam; and the lower part is brown, firm clay loam. The underlying material, to a depth of 60 inches, is light yellowish brown, firm clay loam. In many narrow and irregularly shaped areas the surface layer is loam. In some places the subsoil is thinner and less deep to carbonates.

Included with this soil in mapping are areas of Blount loam, 1 to 3 percent slopes, in small nearly level areas or minor drainageways. A few narrow areas of Pewamo soils are in small drainageways and narrow areas at the base of some slopes. These soils dry out more slowly in spring than the Morley soil. Also included are narrow areas of Morley sandy loam and silt loam that have slopes of more than 6 percent and small areas of Metea loamy sand. These soils dry out sooner in spring than the gently sloping Morley soil, and the Metea soil often lacks sufficient soil moisture for crop growth by summer.

Available water capacity is high, and permeability is slow or moderately slow. The organic matter content is moderate. Surface runoff is medium. The surface layer is very friable and easily tilled throughout a wide range of moisture content.

Most of the acreage of this soil is farmed and used for corn, soybeans, and small grain. Some areas are used for hay or pasture, and a few areas are used for woodland. This soil has good potential for crops and fair potential for sanitary facilities and building sites.

This soil is well suited to corn, soybeans, and small grain. Erosion is the main hazard, and droughtiness in late summer is also a limitation. If the soil is cultivated, conservation practices are needed to control erosion and surface runoff. Crop rotation, minimum tillage, contour farming, or grassed waterways help to prevent excessive soil loss. Using crop residue and growing cover crops and green manure crops help to control erosion and improve and maintain tilth and organic matter content of this soil.

This soil is well suited to grasses and legumes for hay and pasture. Hay and pasture are effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, but only a few areas remain in woodland. Most wooded areas have been grazed. This soil is moderately limited by plant competition. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling. Woodland management also includes excluding livestock, harvesting mature trees, and saving desired seed trees.

This soil has moderate limitations for building sites. Foundations, footings, and basement walls should be properly designed to prevent structural damage caused by low strength and shrinking and swelling. This soil has severe limitations for septic tank absorption fields because of the slow or moderately slow permeability and wetness. Enlarging the filter field or using holding tanks compensates for the reduced permeability. The base for local roads and streets can be strengthened with more suitable material.

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

MsB—Morley silt loam, 2 to 6 percent slopes. This soil is gently sloping, deep, and moderately well drained. It is on undulating upland till plains and moraines. The slopes are short. Most areas are irregularly shaped, and some are elongated. They range from 4 to 100 acres in size.

In a typical profile the surface layer is dark grayish brown silt loam about 7 inches thick. The subsoil is about 28 inches thick. The upper part is dark yellowish brown, firm silty clay loam, and the lower part is dark yellowish brown, firm clay loam. The underlying material, to a depth of about 60 inches, is grayish brown clay loam. In small, steeper, eroded areas the subsoil has been mixed into the surface layer by plowing and the plow layer is dark yellowish brown silty clay loam or clay loam. In some places the subsoil is thicker and the soil is deeper to calcareous clay loam. In many areas the lower part of the subsoil has mottles.

Included with this soil in mapping are a few small areas of nearly level Aubbeenaubbee, Blount, and Pewamo soils in shallow depressions and minor drainageways. These more poorly drained soils dry out more slowly in spring than the Morley soil. Also included along drainageways are small areas of Morley sandy loam and Metea soils that have slopes of more than 6 percent. Also included in deep depressions are small areas of marsh.

Available water capacity is high, and permeability is moderately slow or slow. The organic matter content is moderate. Surface runoff is medium. The surface layer is friable and easily tilled throughout a wide range of moisture content. The surface tends to crust after heavy rains, especially where the plow layer contains subsoil material.

Most of the acreage of this soil is farmed. Most areas are used for corn, soybeans, and small grain. Some areas are used for hay or pasture. A few areas are used for woodland. This soil has good potential for crops and fair potential for sanitary facilities and building sites.

This soil is well suited to corn, soybeans, and small grain. If the soil is cultivated, conservation practices are needed to control erosion and surface runoff. Crop rotation, minimum tillage, diversions, contour farming, grassed waterways, or grade stabilization structures help to prevent excessive soil loss. Using crop residue and growing cover crops and green manure crops help to control erosion and improve and maintain tilth and organic matter content of this soil.

This soil is well suited to grasses and legumes for hay and pasture. Hay and pasture are effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, but only a few areas are in woodland. Most wooded areas are grazed. This soil is moderately limited by plant competition. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling. Woodland management also includes excluding livestock, harvesting mature trees, and saving desired seed trees.

This soil has moderate limitations for building sites. Foundations, footings, and basement walls should be properly designed to prevent structural damage caused by low strength and shrinking and swelling. This soil has severe limitations for septic tank absorption fields because of the slow or moderately slow permeability and wetness. Enlarging the filter field or using holding tanks compensates for the reduced permeability. The base for local roads and streets can be strengthened with more suitable material.

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

MsC—Morley silt loam, 6 to 12 percent slopes. This soil is moderately sloping, deep, and moderately well drained. It is on sides of moderately deep to deep drainageways in the upland till plains and moraines. Slopes are short. Most areas are irregularly shaped, but some are elongated. They range from 3 to 20 acres in size.

In a typical profile the surface layer is dark grayish brown silt loam about 7 inches thick. The subsoil is about 26 inches thick. The upper part is dark yellowish brown, firm silty clay loam; the next part is dark yellowish brown, firm clay loam; and the lower part is dark yellowish brown, firm clay loam. The underlying material, to a depth of 60 inches, is grayish brown clay loam. In some places the subsoil is thinner and the soil is less deep to calcareous clay loam. In small eroded areas the subsoil has been mixed into the surface layer by plowing and the plow layer is dark yellowish brown silty clay loam or clay loam. Seedbed preparation is more difficult in these areas and the soil dries out more slowly.

Included with this soil in mapping along drainageways are small areas of soils that have slopes of more than 12 percent. Also included are small areas where slopes are less than 6 percent.

Available water capacity is high, and permeability is moderately slow or slow. The organic matter content is moderate. Surface runoff is medium. The surface layer is friable and easily tilled throughout a wide range of moisture content.

Most of the acreage of this soil is used for hay or pasture. Some areas are used for woodland, and a few areas are used for corn, soybeans, and small grain. This soil has fair potential for crops and good potential for hay or pasture. It has poor potential for sanitary facilities and building sites.

This soil is suited to corn, soybeans, and small grain. If the soil is cultivated, conservation practices are needed to control erosion and surface runoff. Crop rotation, minimum tillage, diversions, contour farming, grassed waterways, or grade stabilization structures help to prevent excessive soil loss. Using crop residues and growing cover crops and green manure crops help to control erosion and improve and maintain tilth and organic matter content of this soil.

This soil is well suited to grasses and legumes for hay and pasture. Hay and pasture are effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Stocking at proper rates, pasture renovation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, and many areas are in small woodlots. Most wooded areas are grazed. This soil is moderately limited by plant competition. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling. Woodland management also includes excluding livestock, harvesting mature trees, and saving desired seed trees.

This soil has severe limitations for building sites because of slope. Grading the area or cutting and filling to modify the slope or designing the project to complement the slope overcomes the limitation. Foundations, footings, and basement walls should be properly designed to prevent structural damage caused by low strength and shrinking and swelling. This soil has severe limitations for septic tank absorption fields because of wetness and moderately slow and slow permeability. Steep slope is also a limitation. The absorption fields can be designed to operate properly on these slopes and should be enlarged to compensate for the reduced permeability. Strengthening the base for local roads and streets with suitable material compensates for low strength and frost action.

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

MsD—Morley silt loam, 12 to 18 percent slopes. This soil is strongly sloping, deep, and moderately well drained. It is on ridges and sides of deep drainageways in the upland till plains and moraines. Slopes are short. Most areas are irregularly shaped or elongated and range from 4 to 30 acres in size.

In a typical profile the surface layer is dark grayish brown silt loam about 7 inches thick. The subsoil is about 22 inches thick. The upper part is dark yellowish brown, firm silty clay loam, and the lower part is dark yellowish brown, firm clay loam. The underlying material, to a depth of 60 inches, is grayish brown clay loam. In some areas the subsoil is thinner and the soil is less deep to calcareous clay loam. In small eroded areas the subsoil has been mixed into the surface layer by plowing and the plow layer is dark yellowish brown silty clay loam or clay loam. Seedbed preparation is more difficult in these areas and the soil dries out more slowly. In these areas the depth to the calcareous underlying material varies within short distances and many spots are calcareous at depths of less than 25 inches.

Included with this soil in mapping are small areas along drainageways that have slopes greater than 18 percent and small areas that have slopes of less than 12 percent. Also included are a few narrow areas of steep and very steep Hennepin silt loam bordering major drainageways.

Available water capacity is high, and permeability is moderately slow or slow. The organic matter content is moderate. Surface runoff is rapid. The surface layer is friable and easily tilled throughout a wide range of moisture content.

Most of the acreage of this soil is used for hay or pasture. Some areas are used for woodland, and a few areas are used for corn, soybeans, and small grain. This soil has poor potential for crops, sanitary facilities, and building sites. It has good potential for pasture or hay.

This soil is poorly suited to corn, soybeans, and small grain because of the very severe hazard of erosion. If the soil is cultivated, extensive conservation practices are needed to control erosion and surface runoff. Minimum tillage, diversions, contour farming, grassed waterways, or grade stabilization structures help to prevent excessive soil loss. Using crop residue and growing cover crops and green manure crops help to control erosion and improve and maintain tilth and organic matter content of this soil. Growing grasses and legumes for hay and pasture most of the time is most effective in reducing runoff and controlling erosion.

This soil is well suited to grasses and legumes for hay and pasture. Hay and pasture are effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Stocking at proper rates, pasture renovation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, and many areas are in small woodlots. Most wooded areas are grazed. This soil is moderately limited by plant competition. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling. Woodland management also includes excluding livestock, harvesting mature trees, and saving desired seed trees.

This soil has severe limitations for building sites because of slope. Grading the area or cutting and filling to modify the slope or designing the project to complement the slope overcomes the hazard. Foundations, footings, and basement walls should be properly designed to prevent structural damage caused by low strength and shrinking and swelling. This soil has severe limitations for septic tank absorption fields because of slope and moderately slow or slow permeability. The absorption field can be designed to operate properly on these slopes and should be enlarged to compensate for the reduced permeability. Strengthening the base for local roads and streets with suitable material compensates for low strength and frost action.

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

MtC3—Morley silty clay loam, 6 to 12 percent slopes, severely eroded. This soil is moderately sloping, deep, and moderately well drained. It is on sides of moderately deep to deep drainageways in the upland till plains and moraines. Slopes are short. Slope is dominantly 9 to 12 percent. Most areas are irregularly shaped, but some are elongated. They range from 4 to 60 acres in size.

In a typical profile the surface layer is dark yellowish brown silty clay loam about 7 inches thick. The subsoil is dark yellowish brown, firm clay loam about 24 inches thick. The underlying material, to a depth of 60 inches, is grayish brown clay loam. In some small areas the surface layer is dark grayish brown silt loam that is friable and easy to plow and dries out sooner in spring. In some small areas the underlying material has been mixed with the subsoil by plowing and the plow layer is grayish brown, cloddy clay loam. In most areas the depth to the calcareous underlying material varies within short distances and many spots are calcareous at a depth of less than 20 inches.

Included with this soil in mapping are a few narrow areas of less sloping and less eroded Morley soils near the top of some slopes. Also included are small areas that have slopes of more than 12 percent and a few narrow areas of steep and very steep Hennepin silt loam.

Available water capacity is high, and permeability is moderately slow or slow. The organic matter content is moderate. Surface runoff is rapid. This soil is difficult to plow, and clods form if the soil is plowed when too wet. The clods are difficult to break down into a suitable seedbed.

Most of the acreage of this soil is farmed. Many areas are used for corn, soybeans, and small grain. Some areas are used for hay and pasture. This soil has poor potential for crops and good potential for hay or pasture. It has poor potential for sanitary facilities and building sites.

This soil is poorly suited to corn, soybeans, and small grain because of the very severe hazard of further erosion. If the soil is cultivated, extensive conservation practices are needed to control erosion and surface runoff. Minimum tillage, diversions, contour farming, grassed waterways, or grade stabilization structures help to prevent excessive soil loss. Using crop residues and growing cover crops and green manure crops help to control erosion and improve and maintain tilth and organic matter content of this soil. Growing grasses and legumes for hay and pasture most of the time is most effective in reducing runoff and controlling erosion.

This soil is well suited to grasses and legumes for hay and pasture. Hay and pasture are effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Stocking at proper rates, pasture renovation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, and a few areas are in small woodlots that are generally grazed. This soil is moderately limited by plant competition. Seedlings survive and grow well if competing vegetation is controlled and livestock are excluded. Unwanted trees and shrubs can be removed by site preparation or by spraying, cutting, or girdling.

This soil has severe limitations for building sites because of slope. Grading the area or cutting and filling to modify the slope or designing the project to complement the slope overcomes the limitation. Foundations, footings, and basement walls should be properly designed to prevent structural damage caused by low strength and shrinking and swelling. This soil has severe limitations for septic tank absorption fields because of wetness and slow or moderately slow permeability. The absorption field can be designed to operate properly on these slopes and should be enlarged to compensate for the reduced permeability. Strengthening the base for local roads and streets with suitable material compensates for low strength and frost action.

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

MtD3—Morley silty clay loam, 12 to 25 percent slopes, severely eroded. This soil is strongly sloping, deep, and moderately well drained. It is on ridges and sides of deep drainageways in the upland till plains and moraines. Slopes are short. Areas are irregularly shaped or elongated and range from 5 to 40 acres in size.

In a typical profile the surface layer is dark yellowish brown silty clay loam about 7 inches thick. The subsoil is dark yellowish brown, firm clay loam about 20 inches thick. The underlying material, to a depth of 60 inches, is grayish brown clay loam. In some small areas the surface layer is dark grayish brown silt loam that is friable and easy to plow and dries out sooner in spring. In some small areas the underlying material has been mixed with the subsoil by plowing and the plow layer is grayish brown, cloddy silty clay loam. In most areas the depth to the calcareous underlying material varies within short distances and many spots are calcareous at a depth of less than 20 inches.

Included with this soil in mapping bordering major drainageways are small areas where slopes are more than 18 percent and small areas, near the top of slopes where slopes are less than 12 percent. Included with this soil in mapping are a few narrow areas of steep and very steep Hennepin silt loam.

Available water capacity is high, and permeability is moderately slow or slow. The organic matter content is moderate. Surface runoff is very rapid. This soil is difficult to plow, and clods form if the soil is plowed when too wet. The clods are difficult to break down into a suitable seedbed.

Most of the acreage of this soil is used for grasses and legumes for pasture or hay. Some areas are used for corn, soybeans, or small grain. This soil has poor potential for crops and fair potential for hay or pasture. It has poor potential for sanitary facilities and building sites.

This soil is generally unsuitable for corn, soybeans, or small grain crops because of the very severe hazard of further erosion. Surface runoff is very rapid. Small grain is occasionally grown so that stands of grasses and legumes can be reestablished. Minimum tillage, diversions, grassed waterways, and using crop residue help to prevent excessive soil loss. Growing grasses and legumes most of the time is most effective in reducing surface runoff and controlling erosion.

This soil is suited to grasses and legumes for hay and pasture. Hay and pasture are effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Stocking at proper rates, pasture renovation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, and a few areas are in small woodlots that are generally grazed. This soil is moderately limited by plant competition. Seedlings survive and grow well if competing vegetation is controlled and livestock are excluded. Unwanted trees and shrubs can be removed by site preparation or by spraying, cutting, or girdling.

This soil has severe limitations for building sites because of slope. Grading the area or cutting and filling to modify the slope or designing the project to complement the slope overcomes the limitation. Foundations, footings, and basement walls should be properly designed to prevent structural damage caused by low strength and shrinking and swelling. This soil has severe limitations for septic tank absorption fields because of slope and moderately slow or slow permeability. The absorption field can be designed to operate properly on these slopes and should be enlarged to overcome the reduced permeability. Strengthening the base for local roads and streets with suitable material compensates for low strength and frost action.

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

OcA—Ockley silt loam, 0 to 2 percent slopes. This nearly level soil is deep and well drained. It is on broad outwash terraces along the valleys of major streams. Most areas are elongated, and some are irregular. They range from 4 to 60 acres in size.

In a typical profile the surface layer is dark brown silt loam about 9 inches thick. The subsurface layer is dark yellowish brown silt loam about 3 inches thick. The subsoil is about 36 inches thick. The upper part is brown, firm silty clay loam or clay loam, and the lower part is dark brown, firm gravelly clay loam. The underlying material, to a depth of 60 inches, is brown, loose, stratified gravelly sand and sand. In some places the silt mantle is 2 or 3 feet thick and the soil is deeper over calcareous gravelly sand and sand. In small areas the surface layer is loam. In many small areas gravelly sand and sand is at a depth of 30 to 40 inches. These areas dry out sooner in spring and by late summer often lack sufficient moisture for crop growth.

Included with this soil in mapping are small areas of Rensselaer and Sleeth soils slightly lower in elevation. These soils dry out more slowly in spring than the Ockley soil and generally have sufficient soil moisture for crop growth.

Available water capacity is high, and permeability is moderate. The organic matter content of the surface layer is moderate. Surface runoff is slow. The surface layer is friable and easily tilled throughout a wide range of moisture content.

Most of the acreage of this soil is farmed. Most areas are used for corn or soybeans. A few areas are used for forage grasses and legumes, small grain, and woodland. This soil has good potential for crops and for sanitary facilities and building sites.

This soil is well suited to all crops commonly grown in the county. It has few limitations for crops. Droughtiness in late summer is a slight limitation. Minimum tillage, growing winter cover crops, and using crop residue help to maintain and improve the organic matter content and maintain good tilth.

This soil is well suited to grasses and legumes for forage. When this soil is used for hay or pasture, the major concerns of management are a slight limitation of droughtiness in late summer, overgrazing, and grazing when the soil is wet. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, but only a few areas remain in woodland. Most wooded areas have been grazed. The main limitation for woodland use is plant competition. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling. Woodland management also includes excluding livestock, harvesting mature trees, and saving desired seed trees.

This soil has moderate limitations for building sites because of low strength and shrinking and swelling. Foundations, footings, and basement walls should be properly designed to prevent structural damage caused by low strength and shrinking and swelling. This soil has only slight limitations for septic tank absorption fields because it is moderately permeable. There is a hazard of polluting the underground water supply.

Limitations are severe for local roads and streets because of low strength. Shrinking and swelling and frost action are also limitations. The base material can be strengthened with more suitable material.

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

OcB—Ockley silt loam, 2 to 6 percent slopes. This gently sloping soil is deep and well drained. It is on broad outwash terraces along the valleys of major streams. Most areas are elongated, and some are irregular. They range from 3 to 30 acres in size.

In a typical profile the surface layer is dark yellowish brown silt loam about 9 inches thick. The subsoil is about 36 inches thick. The upper part is brown, firm silty clay loam or clay loam, and the lower part is dark brown, firm gravelly clay loam. The underlying material, to a depth of 60 inches, is brown, loose, stratified gravelly sand and sand. In some places the silt mantle is 2 or 3 feet thick and the soil is deeper to calcareous gravelly sand and sand. In some small areas the underlying gravelly sand and sand is at a depth of 30 to 40 inches. Here the soil dries out sooner in spring and by late summer often lacks sufficient moisture for crop growth. In small, eroded, steeper areas the subsoil has been mixed into the surface soil by plowing, and the plow layer is dark yellowish brown silty clay loam or clay loam. Here the soil dries out more slowly, is more difficult to plow, and forms clods that are difficult to break down into a friable seedbed.

Included with this soil in mapping are areas of nearly level Rensselaer and Sleeth soils. These soils are more poorly drained and slightly lower in elevation than the Ockley soil. They dry out more slowly in spring and have sufficient soil moisture for crop growth.

Available water capacity is high, and permeability is moderate. The organic matter content of the surface layer is moderate. Surface runoff is medium. The surface layer is friable and easily tilled throughout a wide range of moisture content.

Most areas of this soil are used for corn and soybeans. Some areas are used for small grain, grasses and legumes for forage, and woodland. This soil has good potential for crops, for hay or pasture, and for sanitary facilities and building sites.

This soil is well suited to corn, soybeans, and small grain. Conservation practices are needed to control erosion and surface runoff if cultivated crops are grown. Crop rotation, minimum tillage, diversions, contour farming, grassed waterways, or grade stabilization structures help to prevent excessive soil loss. Using crop residue and growing cover crops and green manure crops help to control erosion and improve and maintain tilth and organic matter content of this soil.

This soil is well suited to grasses and legumes for hay and pasture. Hay and pasture are effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, but only a few areas are in woodland. Most wooded areas are grazed. This soil is moderately limited by plant competition. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling. Woodland management also includes excluding livestock, harvesting mature trees, and saving desired seed trees.

This soil has moderate limitations for building sites because of low strength and shrinking and swelling. Foundations, footings, and basement walls should be properly designed to prevent structural damage caused by low strength and shrinking and swelling. This soil has only slight limitations for septic tank absorption fields because it is moderately permeable. There is a hazard of polluting the underground water supply.

Limitations are severe for local roads and streets because the soil has low strength. Shrinking and swelling and frost action are also limitations. The base material can be strengthened with more suitable material.

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

Or—Orthents, loamy. These soils are nearly level to moderately sloping, deep, and well drained to poorly drained. They are in disturbed areas on uplands, terraces, and bottom land around highway interchanges, shopping centers, and factories and in rural areas. In places, deep cuts have been made in the original land surface and the removed soil material, or "borrow," has been used to fill in lower lying areas and provide a smoother, more nearly level landform. In other places, the soil material has been used as fill for highway grades and overpasses and exit ramps. Many borrow areas have filled with water and are used for various types of recreation and wildlife habitat. Areas range from 3 to 100 acres in size, but the size is commonly about 10 acres.

In a typical area of fill, the soil is a mixture of surface soil, subsoil, and substratum. Texture is silt loam, loam, and clay loam that may contain some gravel, sand, or stones. In a typical area where a deep cut has been made, the material is mainly loam or clay loam glacial till or gravelly sand.

Included with these soils in mapping are small areas where slopes are short and steep; areas of sand, gravel, and stones; and areas where bedrock crops out. Highways and other public works and buildings cover much of some areas.

Available water capacity is moderate, and permeability is moderate to slow. Organic matter content of the surface layer is low, and reaction is slightly acid to mildly alkaline.

Most areas of these soils are in permanent grass or low growing shrubs because access to them is limited. Many areas are surrounded by heavily traveled highways.

Special management, including an intensified fertilization program with special emphasis on using organic residue or manure, is needed if these areas are used for crops. Conservation practices are needed to control erosion in the gently sloping and moderately sloping areas. Drainage is needed in some nearly level areas. Exposed areas should be revegetated as soon as possible after construction. Diversions, box inlet structures, grade stabilization structures, and grassed waterways can be used to control erosion.

Onsite investigation is needed if these soils are to be used as building sites. The depth to the water table and its relation to frost-action potential should be considered. Because the soil material is quite variable, engineering tests are needed. The soil properties significant to the design of a structure vary from one location to another. If these areas are used as building sites, removal of vegetation should be held to a minimum and protective plant cover should be established as quickly as possible to keep erosion to a minimum. Some nearly level areas need drainage. The limitations of these soils for septic tank absorption fields are variable. Onsite investigation is needed. Attention should be given to wetness and permeability in nearly level areas and to slope and permeability in gently sloping and moderately sloping areas.

These soils are in capability subclass VIe and woodland suitability subclass 3o.

OsB—Ormas-Oshtemo loamy sands, 2 to 8 percent slopes. These gently sloping and moderately sloping soils are deep and well drained. They are on broad outwash terraces along the valleys of major streams. Most areas are irregularly shaped, and some are elongated. They range from 4 to 40 acres in size.

The areas are about 50 percent Ormas soils and 30 percent Oshtemo soils. The Ormas soils are on ridgetops and east- and south-facing side slopes. The Oshtemo soils are mostly on the north- and west-facing side slopes and at lower elevations.

In a typical profile of the Ormas soil, the surface layer is brown loamy sand and sand about 38 inches thick. The subsoil is about 21 inches thick. The upper part is brown, friable sandy loam; the next part is brown, firm gravelly sandy clay loam; and the lower part is brown, friable gravelly sandy loam. The underlying material, to a depth of 64 inches, is yellowish brown, loose, stratified gravelly sand and sand. In some areas the surface layer and subsoil are thicker. In many areas the subsoil has less clay and gravel and contains strata of loamy sand or sand.

In a typical profile of Oshtemo soils, the surface layer is brown loamy sand about 13 inches thick. The subsoil is about 35 inches thick. The upper part is brown, very friable sandy loam; the next part is yellowish brown, firm loam; and the lower part is yellowish brown, friable sandy loam. The underlying material, to a depth of 60 inches, is yellowish brown, loose, stratified gravelly sand and sand. In some areas the surface layer and subsoil are thicker. Also included are many areas of soils that have a gravelly sandy loam, sandy clay loam, or gravelly clay loam subsoil.

Included with these soils in mapping and making up 20 percent of the unit are areas of Chelsea, Fox, and Oshtemo sandy loams. Also included are areas with slopes of less than 2 percent or more than 8 percent.

These soils have moderate available water capacity. Permeability is moderately rapid in the surface layer and subsoil and rapid in the substratum. The organic matter content of the surface layer is moderate. Surface runoff is slow or medium. The surface layer is very friable and easily tilled throughout a wide range of moisture content.

Most of the acreage of these soils is farmed. Most areas are used for corn, soybeans, or small grain. Some areas are used for hay or pasture, and a few areas are used for woodland. Potential is fair for crops and good for sanitary facilities and building sites.

These soils are suited to corn and soybeans and well suited to small grain and grasses and legumes for forage. Limitations are moderate for corn and soybeans. Droughtiness, moderate available water capacity, and wind erosion are limitations. Blowing sand grains often cover up or cut off seedlings of small plants. With irrigation and proper management, the soils are suited to intensive row cropping. Growing grasses and legumes for forage most of the time is most effective in reducing wind erosion. Minimum tillage, growing winter cover crops, and using crop residue help maintain and improve organic matter content, reduce wind erosion, and maintain good tilth.

These soils are well suited to trees, but only a few areas remain in woodland. Most wooded areas have been grazed. The main limitations for woodland use are seedling mortality and plant competition. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling.

These soils have only slight limitations for septic tank absorption fields. There is a hazard of polluting the underground water supply. Limitations are slight for building sites and for local streets and roads. Limitations for shallow excavations are severe because cutbanks readily cave.

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

OtA—Oshtemo sandy loam, 0 to 4 percent slopes. This soil is nearly level, deep, and well drained. It is mainly on broad outwash terraces along the valleys of major streams. Small areas are on moraines. Slope is dominantly less than 1 percent. Most areas are irregularly shaped, and some are elongated. They range from 4 to 100 acres in size.

In a typical profile the surface layer is dark brown sandy loam about 11 inches thick. The subsoil is about 40 inches thick. The upper part is dark yellowish brown, very friable sandy loam; the middle part is dark brown, friable sandy loam; and the lower part is dark brown, very friable loamy fine sand. The underlying material, to a depth of 60 inches, is dark yellowish brown, loose, stratified gravel and sand. In some areas the surface layer and subsoil are thicker. In some areas the surface layer has less sand.

Included with this soil in mapping are various-sized areas of soils that have less sand in the surface layer and are less deep to calcareous gravelly sand and sand than the Oshtemo soil. Also included are many narrow areas of Ormas and Oshtemo loamy sands, Fox silt loam, and Chelsea fine sand. A few areas have slopes greater than 4 percent, and many areas have short steep slopes.

Available water capacity is moderate. Permeability is moderately rapid in the subsoil and rapid in the substratum. The organic matter content is moderate. Surface runoff is slow. The surface layer is very friable and easily tilled throughout a wide range of moisture content.

Most of the acreage of this soil is farmed. It is used for corn, soybeans, and small grain. A few areas are used for forage grasses and legumes or for woodland. This soil has fair potential for crops and for hay or pasture. It has good potential for sanitary facilities and building sites.

This soil is suited to corn and soybeans and well suited to small grain and grasses and legumes for forage. This soil has moderate limitations for corn and soybeans. Droughtiness is a moderate limitation. With irrigation and proper management, this soil is suited to intensive row cropping. Minimum tillage, growing winter cover crops, and using crop residue help to maintain and improve organic matter content and maintain good tilth.

This soil is well suited to trees, but only a few areas remain in woodland. Most wooded areas have been grazed. This soil is moderately limited by plant competition. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling. Woodland management also includes excluding livestock, harvesting mature trees, and saving desired seed trees.

This soil has only slight limitations for building sites and for local roads and streets. Cutbanks cave readily in shallow excavations. This soil has slight limitations for septic tank absorption fields, but there is a hazard of polluting the underground water supply.

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

Pm—Palms muck, drained. This soil is nearly level, deep, and very poorly drained. It formed in organic material in deep depressions in moraines, till plains, outwash plains, and alluvial plains that were formerly shallow lakes or marshes. It is frequently ponded by runoff from adjacent higher lying areas. Areas are irregularly shaped or circular and range from 3 to 200 acres in size.

In a typical profile the surface layer is black muck about 12 inches thick. The next layer, to a depth of about 25 inches, is black and very dark grayish brown muck. The underlying material, to a depth of 60 inches, is very dark gray silt loam. In a few large areas on the alluvial plain the organic layer is less than 16 inches thick and the underlying material is silty clay loam.

Included with this soil in mapping are many small areas in slightly deeper depressions where the organic material is more than 50 inches deep. These soils dry out more slowly in spring and are more likely to flood during the growing season than the Palms soils. Also included around the edges of mapped areas, at a slightly higher elevation, are many narrow areas of Brookston, Pewamo, Rensselaer, and Washtenaw soils. These soils dry out sooner in spring and are less likely to flood during the growing season than the Palms soil. Many areas in the northern third of the county are not drained or have drainage that is not adequate for crop production.

Available water capacity is very high. Permeability is moderately rapid in the organic material and moderate in the underlying mineral material. Organic matter content in the surface layer is very high. Surface runoff is very slow. The surface layer is friable and easily tilled; however, because of very slow runoff, the high water table, and ponding of water from adjacent higher ground, this soil often remains wet late in spring.

Most of the acreage of this soil is farmed. Corn is the main crop. Small areas of this soil are used for soybeans, small grain, and grasses for hay or pasture. If adequately drained, this soil has good potential for cultivated crops and grasses for hay or pasture. Undrained areas provide wetland wildlife habitat. The soil has poor potential for woodland, sanitary facilities, and building sites.

This soil is well suited to corn. Wetness is the major limitation, and wind erosion is a hazard in large areas that are drained and cultivated. Artificial drainage is necessary for crops. Tile, open ditch, and pump drainage, individually or in combination, are common. Diversions also help in controlling wetness. Minimum tillage, tilling at the proper moisture content, growing cover crops, and various types of windbreaks reduce wind erosion and increase water infiltration.

This soil is suited to grasses and legumes for forage, but it is poorly suited to deep rooted legumes such as alfalfa because the high water table restricts root growth and frost heave is a serious limitation. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is very poorly suited to trees. A few areas remain in native hardwoods or shrubs and are used mainly for wildlife habitat. There are severe limitations for planting or harvesting trees. Only water-tolerant trees survive and grow on this soil if the soil is not drained.

This soil has severe limitations for building sites, septic tank absorption fields, and local roads and streets. It is generally unsuitable for these uses because it is wet, floods, and has low strength and high potential frost action. The soil features are such severe limitations and so difficult to overcome that selecting another site may be the best option. Local roads and streets are subject to wetness, subsidence, and poor stability. Excess water can be removed by drainage ditches. The organic material should be removed and the areas refilled with suitable material to improve stability.

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

Pt—Patton silty clay loam. This soil is nearly level, deep, and poorly drained. It is in slight depressions on broad, slightly undulating till plains. Areas are oval or circular and range from 10 to 200 acres in size.

In a typical profile the surface layer is very dark gray silty clay loam about 10 inches thick. The subsoil is about 28 inches thick. The upper part is very dark gray and dark gray, mottled, firm silty clay loam, and the lower part is gray, mottled, firm silty clay loam. The underlying material, to a depth of 60 inches, is calcareous, gray, mottled, friable silty sediment. In some areas the very dark gray surface layer is less than 10 inches thick. In places several inches of stratified sand and gravelly sand is in the underlying material.

Included with this soil in mapping are narrow and irregularly shaped areas of soils that have a more clayey subsoil than the Patton soil. These soils are at the edges of and throughout the mapped areas. Also included are a few irregularly shaped and narrow areas of somewhat poorly drained Blount soils on slight rises.

Available water capacity is high, and permeability is moderate. The organic matter content of the surface layer is high. Surface runoff is slow. Some areas are ponded. The water table is between the surface and a depth of 1 foot in winter and spring and restricts the depth to which plant roots penetrate. Clods form if this soil is plowed when wet. Clods are difficult to break down into a friable seedbed.

Most of the acreage of this soil is farmed. Most areas are used for corn and soybeans. A few areas are used for forage grasses and legumes and for woodland. If adequately drained, this soil has good potential for crops. It has poor potential for sanitary facilities and building sites.

This soil is well suited to corn and soybeans. Wetness is the main limitation. If this soil is adequately drained, row crops can be grown most of the time. Minimum tillage, using crop residue, and growing cover crops help to maintain and improve organic matter content and maintain good tilth.

This soil is generally well suited to grasses and legumes for forage. It is poorly suited to deep rooted legumes because the high water table restricts the downward movement of roots and water. If this soil is used for pasture, the major concerns of management are overgrazing and grazing when the soil is wet. Grazing when the soil is wet causes surface compaction and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, but only a few areas are in woodland. This soil has a prolonged seasonal high water table that delays harvest. Trees that tolerate wetness are favored in stands. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling.

This soil has severe limitations for building sites and septic tank absorption fields because it is wet and subject to brief flooding. Dwellings and small buildings should be constructed without basements, and foundations and footings should be designed to prevent structural damage caused by low strength. The water table in this soil can be lowered and the frequency and duration of flooding reduced by an adequate drainage system. A central sewage system and storm sewers are usually needed. Local streets and roads are also subject to wetness and brief flooding. Strengthening the base with suitable material reduces frost action, and excess water can be removed by ditches.

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

Pw—Pewamo silty clay loam. This soil is nearly level, deep, and very poorly drained. It is in slight depressions on broad slightly undulating upland till plains and moraines. It is frequently ponded by runoff from adjacent higher lying areas. Areas are generally irregularly shaped and range from 3 to 500 acres in size.

In a typical profile the surface layer is very dark gray and black silty clay loam about 13 inches thick. The subsoil is about 30 inches thick. The upper part is dark gray and olive gray, mottled, very firm silty clay, and the lower part is gray, mottled, firm silty clay loam or clay loam. The substratum, to a depth of 60 inches, is light brownish gray, mottled clay loam. In some areas the very dark gray surface layer and black subsurface layer combined are less than 10 inches thick. In a few areas in the northern part of the county, the subsoil is less clayey.

Included with this soil in mapping are many, small, irregularly shaped and narrow areas of somewhat poorly drained Blount silt loam on slight rises. A few areas of moderately well drained Morley silt loam on gentle slopes along the sides of small drainageways are also included. These soils dry out more quickly in spring than the Pewamo soil. Also included are small areas that are ponded for long periods.

Available water capacity is high, and permeability is moderately slow. The organic matter content of the surface layer is high. Surface runoff is very slow. The water table is between the surface and a depth of 1 foot in winter and spring and restricts the depth to which plant roots penetrate. Clods form if this soil is plowed when wet. Clods are difficult to break down into a friable seedbed.

Most of the acreage of this soil is farmed. Most areas are used for corn and soybeans. A few areas are used for tomatoes, hay, pasture, and woodland. If adequately drained, this soil has good potential for crops. It has poor potential for sanitary facilities and building sites.

This soil is well suited to corn and soybeans. Wetness is the main limitation in use and management of this soil. If the soil is adequately drained, row crops can be grown most of the time. Minimum tillage, using crop residue, and growing cover crops help to maintain and improve organic matter content and maintain good tilth.

This soil is well suited to grasses for hay and pasture but poorly suited to deep rooted legumes because the high water table restricts downward movement of roots and water. If this soil is used for pasture, the major concerns of management are overgrazing and grazing when the soil is wet. Grazing when the soil is wet causes surface compaction and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, but only a few areas are in woodland. Most wooded areas are grazed. This soil has a prolonged seasonal high water table that delays harvest. Trees that tolerate wetness are favored in stands. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling.

This soil has severe limitations for building sites and septic tank absorption fields because it is wet and subject to brief flooding. Dwellings and small buildings should be constructed without basements, and foundations and footings should be designed to prevent structural damage caused by low strength. The high water table of this soil can be lowered and the frequency and duration of flooding reduced by an adequate drainage system. Since this soil percs slowly, a central sewage system and storm sewers are usually needed. Local streets and roads are also subject to wetness and brief flooding. Strengthening the base with suitable material reduces frost action, and excess water can be removed by ditches.

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

Pz—Pits, quarry, limestone. This gently sloping to very steep area is an active limestone quarry on the outwash terrace. This unit is about 40 acres in size. The area was originally Fox, Millsdale, and Milton soils. Vertical cuts have been made in the original land surface. The soil, underlying material, and heavily fractured limestone have been removed and used to fill in lower lying areas, forming more level land.

The excavated limestone is used for construction and for agricultural lime. Pump drainage is necessary to maintain the lowered water table in the quarry.

There is no vegetation in the active part of the quarry. A sparse plant cover, mainly annual weeds and grasses, grows around the perimeter.

Re—Rensselaer loam. This soil is nearly level, deep, and very poorly drained. It is in slight depressions on broad outwash terraces and in small sluiceways in moraines and outwash areas in slightly undulating till plains. The soil is frequently ponded by runoff from adjacent higher lying areas. Areas are irregularly shaped or elongated. They range from 5 to 150 acres in size.

In a typical profile the surface layer is very dark gray loam about 14 inches thick. The subsoil is mottled, firm clay loam about 27 inches thick. The upper part is olive gray, and the lower part is dark gray. The calcareous underlying material, to a depth of 60 inches, is dark gray loamy sand. In places the dark surface layer is less than 10 inches thick. In some areas the lower part of the subsoil is gravelly clay loam. In some areas in the northern part of the county, the subsoil contains more clay. In some areas the soil is underlain by loamy glacial till.

Included with this soil in mapping are some small, slightly convex, irregularly shaped areas of somewhat poorly drained Sleeth soils and a few areas, along the sides of small drainageways or small mounds, of moderately well drained Morley soils. Also included are small areas that are ponded for long periods.

Available water capacity is high, and permeability is moderate. Organic matter content of the surface layer is high. Surface runoff is ponded or slow. The water table is between the surface and a depth of 1 foot in winter and spring and restricts the depth to which plant roots penetrate. This soil has a friable surface layer that is easy to till. Clods form if this soil is plowed when wet. Clods are difficult to break down into a friable seedbed.

Most of the acreage of this soil is farmed. It is used for corn, soybeans, and small grain. A few areas are used for hay, pasture, or woodland. If adequately drained, this soil has good potential for crops. It has poor potential for sanitary facilities and building sites.

This soil is well suited to corn, soybeans, and small grain. Wetness is the main limitation. Excess water can be removed by open ditches, tile drains, surface drains, pumping, or a combination of these practices. With drainage and proper management, this soil is suited to intensive row cropping. Minimum tillage and using crop residue help to improve and maintain tilth and organic matter content of the soil.

This soil is well suited to grasses and legumes for hay or pasture but poorly suited to deep rooted legumes. A high water table restricts the downward movement of roots and water. If this soil is used for pasture, the major concerns of management are overgrazing or grazing when the soil is wet. Grazing when the soil is wet causes surface compaction and poor tilth. Stocking at proper rates, grazing rotation, and restricted use during wet periods help to reduce surface compaction and maintain good tilth.

This soil is well suited to trees, but only a few areas are in woodland. Most wooded areas are grazed. This soil has a prolonged seasonal high water table that delays harvest. Trees that tolerate wetness are favored in stands. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling.

This soil has severe limitations for building sites and septic tank absorption fields because of a prolonged seasonal high water table and brief flooding. Dwellings and small buildings should be constructed without basements, and foundations and footings should be designed to prevent structural damage caused by low strength and shrinking and swelling. Drainage is difficult in most areas because this soil is often in the lowest part of the landscape. Suitable outlets for drainage systems are often not available, so pumping is needed. Local streets and roads are also subject to wetness and brief flooding. Strengthening the base with suitable material compensates for low strength and frost action. Excess water needs to be removed by ditches.

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

Ro—Ross loam. This soil is nearly level, deep, and well drained. It is on alluvial fans. The small areas consist of irregularly shaped fanlike lobes extending out from small streams in ravines from the upland. The larger areas form an irregular border along the foot of steep or very steep valley sides. This soil is 5 to 20 feet higher than adjacent flood plains. Slope is dominantly about 1 percent. Areas range from 5 to 150 acres in size.

In a typical profile the surface layer is very dark gray loam about 12 inches thick. The underlying material is brown and dark yellowish brown, friable loam to a depth of 37 inches. Below this to a depth of 60 inches, the substratum is dark yellowish brown loam. In some small areas the surface layer is silt loam.

Included with this soil in mapping are small areas of Shoals and Sloan soils, generally along the lower edge of the fans where they merge gradually with the adjoining soils. Also included are small areas of soils that have mottles below a depth of 14 inches. These soils dry out more slowly in spring than the Ross soil. Also included are many areas of soils that have a dark grayish brown or lighter colored surface layer.

Available water capacity is high, and permeability is moderate. Organic matter content of the surface layer is high. Surface runoff is slow. The surface layer is friable and easily tilled throughout a fairly wide range of moisture content.

Almost all of the acreage of this soil is used intensively for corn and soybeans. A few areas are used for small grain, hay, and pasture. This soil has good potential for crops and for building sites.

This soil is well suited to corn, soybeans, and small grain. Drainage ditches have been installed to divert runoff from higher areas. Row crops can be grown most of the time. Minimum tillage, growing winter cover crops, and using crop residue help to maintain and improve organic matter content and maintain good tilth.

This soil is well suited to grasses and legumes for forage. If this soil is used for pasture, the major concerns of management are overgrazing and grazing when the soil is wet. Grazing when the soil is wet causes surface compaction and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, but few areas are in woodland. Plant competition is the main limitation. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling.

This soil has moderate limitations for building sites because of low strength. Foundations and footings should be properly designed to prevent structural damage. This soil has moderate limitations for septic tank absorption fields because of wetness. The water table can be lowered by adequate drainage. Limitations for local streets and roads are severe because of low strength. The base for local roads can be strengthened with more suitable material.

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

Se—Sebewa loam. This soil is nearly level, moderately deep to sand and gravelly sand, and very poorly drained. It is in slightly concave areas in the broad outwash terraces at the edges of some large areas of organic soils and in some small stream valleys. It is frequently ponded by runoff from adjacent higher lying areas. Most areas are elongated, and some are irregular. They range from 5 to 30 acres in size.

In a typical profile the surface layer is very dark gray loam about 12 inches thick. The subsoil is about 21 inches thick. The upper part is dark gray, mottled, firm clay loam; the next part is grayish brown, mottled, firm clay loam; and the lower part is grayish brown, mottled, firm gravelly clay loam. The underlying material, to a depth of 60 inches, is calcareous grayish brown, loose, stratified gravelly sand and sand. In some areas the dark colored surface layer is less than 10 inches thick. In some places the subsoil is thicker and contains less gravel.

Included with this soil in mapping are narrow areas of Oshtemo and Sleeth soils slightly higher in elevation. The Oshtemo soils dry out sooner in spring than the Sebewa soil and by late summer often lack sufficient moisture for crop growth. A few areas stay wet for long periods.

Available water capacity is moderate. Permeability is moderate in the subsoil and rapid in the underlying material. The organic matter content of the surface layer is high. Surface runoff is very slow. Some areas are ponded. The water table is between the surface and a depth of 1 foot in winter and spring. The high water table and moderate depth to loose gravelly sand and sand restrict the depth to which plant roots penetrate. Clods form if this soil is plowed when wet. Clods are difficult to break down into a friable seedbed.

Most of the acreage of this soil is farmed. Most areas are used for corn and soybeans. A few areas are used for hay, pasture, and woodland. If adequately drained, this soil has good potential for crops. It has poor potential for sanitary facilities and building sites.

This soil is well suited to corn and soybeans. Wetness is the main limitation. If the soil is adequately drained, row crops can be grown most of the time. Minimum tillage, using crop residue, and growing cover crops help to maintain and improve organic matter content and maintain good tilth.

This soil is well suited to grasses and legumes for hay or pasture. It is poorly suited to deep rooted legumes, however, because a high water table restricts downward movement of roots and water. If this soil is used for pasture, the major concerns of management are grazing when the soil is too wet and overgrazing. Grazing when the soil is wet causes surface compaction and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, but only a few areas are in woodland. Most wooded areas are grazed. This soil has a prolonged seasonal high water table that delays harvest. Trees that tolerate wetness are favored in stands. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling.

This soil has severe limitations for building sites and septic tank absorption fields because it is wet and is subject to brief flooding. Dwellings and small buildings should be constructed without basements. The high water table can be lowered and the frequency and duration of flooding reduced by an adequate drainage system. A central sewage system and storm sewers are usually needed. Local roads and streets are also subject to wetness and brief flooding. Excess water can be removed by drainage ditches.

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

Sh—Shoals silt loam. This soil is nearly level, deep, and somewhat poorly drained. It is on flood plains. It is rarely flooded. Areas are irregularly shaped on the broad flood plains of rivers and are long and narrow in the valleys of small streams. They range from 3 to 100 acres in size.

In a typical profile the surface layer is dark grayish brown silt loam about 8 inches thick. The underlying material to a depth of 22 inches is yellowish brown and dark grayish brown, mottled, friable silt loam. Beneath this, to a depth of 60 inches, is dark yellowish brown mottled loam. In some areas the surface layer is loam and silty clay loam. In many areas the soil is dominantly gray throughout and has a higher water table. In some areas mottles are below a depth of 20 inches.

Included with this soil in mapping are small, narrow and irregularly shaped areas of well drained Gessie soils. These areas are slightly higher in elevation, dry out more quickly in spring, and are flooded less often and for shorter periods than the Shoals soil. Also included are narrow, concave areas of very poorly drained Sloan soils. These soils dry out more slowly in spring, are more difficult to plow, flood more frequently, and remain ponded, which delays farming operations in spring.

Available water capacity is high, and permeability is moderate. The organic matter content of the surface layer is moderate. Surface runoff is slow. The surface layer is friable and easily tilled throughout a fairly wide range in moisture content.

Almost all of the acreage of this soil on the broad flood plains of rivers is used intensively for corn and soybeans. The narrow flood plains in minor stream valleys are used mainly for pasture and woodland. This soil has good potential for crops in the broad flood plains. It has poor potential for sanitary facilities and building sites.

This soil is well suited to corn, soybeans, and small grain. Wetness is the main limitation and rare flooding is a hazard on the broad flood plains. Late planting or replanting is sometimes necessary because of rare flooding in spring. Large flood control dams reduce the frequency and severity of floods. Artificial drainage is necessary for crop growth and for timely tillage. Tile, open ditch, and surface drainage, individually or in combination, are common. If the soil is adequately drained, row crops can be grown most of the time. Minimum tillage, tilling at the proper moisture content, using crop residue, and growing cover crops help to maintain and improve organic matter content and maintain good tilth.

This soil is generally well suited to grasses and legumes for forage. It is poorly suited to deep rooted legumes because a high water table in spring restricts the downward movement of roots and water and rare flooding is a hazard. If this soil is used for pasture, the major concerns of management are adequate drainage, grazing when the soil is too wet, and overgrazing. Grazing when the soil is wet causes surface compaction and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. A few small areas on large bottom lands and many narrow strips on small bottom lands remain in native hardwoods. Plant competition is the main limitation. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling.

This soil has severe limitations for building sites, local roads and streets, and septic tank absorption fields because it is wet. Flooding is also a limitation for building sites, for which this soil is generally unsuitable. The high potential frost action is a severe limitation for local roads and streets. Elevating the road bed and providing drainage ditches to remove excess water reduce the frost action potential.

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

Sn—Sleeth loam. This soil is nearly level, deep, and somewhat poorly drained. It is on broad, gently undulating outwash terraces. Slope is 0 to 2 percent. Areas are elongated or irregularly shaped and range from 4 to 30 acres in size.

In a typical profile the surface layer is dark grayish brown loam about 10 inches thick. The subsurface layer is grayish brown loam about 4 inches thick. The subsoil is about 31 inches thick. The upper part is yellowish brown, mottled, firm sandy clay loam, and the lower part is grayish brown, mottled, firm gravelly clay loam. The underlying material, to a depth of 60 inches, is yellowish brown very gravelly sand and sand. In some places the subsoil is thicker and the soil is deeper to calcareous gravelly sand. In some areas the underlying material contains strata of loam, sandy loam, or sand.

Included with this soil in mapping are areas of Fox, Ockley, and Oshtemo soils on low knolls, on ridges, or along minor drainageways. These soils dry out sooner in spring than the Sleeth soil and by late summer often lack sufficient soil moisture for crop growth. Also included are narrow, slightly concave areas of Rensselaer and

Sebewa soils. These soils stay wetter for longer periods in spring than the Sleeth soil.

Available water capacity is high, and permeability is moderate. The organic matter content of the surface layer is moderate. Surface runoff is slow. The water table is at a depth of 1 to 3 feet in winter and spring and restricts the depth to which plant roots penetrate.

Most of the acreage of this soil is farmed. Most areas are used for corn and soybeans. A few areas are used for forage grasses and legumes, small grain, and woodland. If drained, this soil has good potential for crops. It has poor potential for sanitary facilities and building sites.

This soil is well suited to corn and soybeans. Wetness is the major limitation in use and management. If the soil is adequately drained, row crops can be grown most of the time. Minimum tillage, using crop residue, and growing cover crops help to maintain and improve organic matter content and maintain good tilth.

This soil is well suited to grasses for hay and pasture but poorly suited to deep rooted legumes such as alfalfa because of wetness and a high water table in spring. If this soil is used for pasture, the major concerns of management are overgrazing and grazing when the soil is wet. Grazing when the soil is wet causes surface compaction and poor tilth. Stocking at proper rates, pasture renovation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to trees, but only a few areas are in woodland. Most wooded areas are grazed. The soil is moderately limited by plant competition. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling.

This soil has severe limitations for building sites because of wetness. An adequate drainage system and storm sewers are needed to lower the water table. Dwellings and small buildings should be constructed without basements, and foundations and footings should be designed to prevent structural damage caused by shrinking and swelling. This soil has severe limitations for local roads and streets because of frost action and low strength. The base can be strengthened with suitable material. Excess water can be removed by ditches. This soil has severe limitations for septic tank absorption fields because of the seasonal high water table. The high water table can be lowered by an adequate drainage system.

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

So—Sloan silty clay loam. This soil is nearly level and very poorly drained. It is on flood plains. It is frequently flooded. Areas are elongated in the valleys of small streams and elongated or irregularly shaped on the flood plains of rivers. They range from 5 to 50 acres in size.

In a typical profile the surface layer is very dark gray silty clay loam about 18 inches thick. The subsoil is about 24 inches thick. The upper part is dark gray, mottled, friable loam; the middle part is dark grayish brown, mottled, friable silt loam; and the lower part is dark grayish brown, mottled, friable clay loam. Below this, to a depth of 60 inches, is stratified olive gray loam alluvium. In most areas the color, thickness, and texture of underlying material varies within short distances.

Included with this soil in mapping are small areas of better drained Gessie and Shoals soils. These soils are slightly higher in elevation, dry out more quickly in spring, and are flooded less often and for shorter periods than the Sloan soil. Also included are small, narrow and irregularly shaped areas of very poorly drained Palms and Milford soils. These soils are slightly lower in elevation, are more poorly drained, and flood more frequently and for longer periods than the Sloan soil. Farming operations are often delayed in the spring because of wetness. Many small areas are ponded for long periods.

Available water capacity is high, and permeability is moderate. Organic matter content of the surface layer is high. Surface water runoff is very slow or ponded. The water table is between the surface and a depth of 1 foot in winter and spring and restricts the depth to which plant roots penetrate. Clods form if this soil is plowed when wet. The clods are difficult to break down into a friable seedbed.

Most of the acreage of this soil is used intensively for corn and soybeans. Some areas are used for small grain and for grasses and legumes for forage. A few areas are used for woodland. If adequately drained, this soil has good potential for crops. It has poor potential for sanitary facilities and building sites.

This soil is well suited to corn and soybeans. Wetness is the main limitation and common flooding is a hazard. Late planting or replanting is sometimes necessary because of ponding caused by surface runoff from the uplands. Large flood control dams reduce the frequency and severity of flooding from streams. Artificial drainage is necessary for crops. Tile, open ditch, and surface drainage, individually or in combination, are common. Terraces that divert the surface water away from these low lying areas also help in controlling wetness. If the soil is adequately drained, row crops can be grown most of the time. Minimum tillage, tilling at the proper moisture content, using crop residue, and growing cover crops help to maintain and improve organic matter content and maintain good tilth.

This soil is generally well suited to grasses and legumes for forage. It is poorly suited to deep rooted legumes such as alfalfa because a high water table restricts downward movement of roots and water and common flooding is a hazard. If this soil is used for pasture, the major concerns of management are adequate drainage, grazing when the soil is too wet, and overgrazing. Grazing when the soil is wet causes surface compaction and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to trees, but only a few areas are in woodland. This soil has a prolonged seasonal high water table that delays harvest. Trees that tolerate wetness are favored in stands. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling.

This soil has severe limitations for building sites, local roads and streets, and septic tank absorption fields because it is wet and subject to common flooding. It is generally unsuitable for building sites. The high potential frost action limits local roads and streets. Roadbeds should be elevated. The high water table of this soil can be lowered by an adequate drainage system.

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

St—Stonelick sandy loam. This soil is nearly level, deep, and well drained. It is on flood plains of large streams. It is occasionally flooded. This soil is on natural levees of streams and in other elongated, slightly elevated areas near the stream channel. Some areas are irregularly shaped. Areas range from 5 to 60 acres in size.

In a typical profile the surface layer is dark grayish brown sandy loam about 10 inches thick. The underlying material to a depth of 40 inches is dark brown, very friable sandy loam and friable loam. Below this, to a depth of 60 inches, it is dark yellowish brown silt loam. In small areas the surface layer is loamy sand.

Included with this soil in mapping are some narrow areas of nearly level Gessie silt loam slightly lower in elevation on either side of the slightly elevated ridges. Also included are small areas of Shoals and Sloan soils in shallow depressions and small drainageways. These soils are more poorly drained than the Stonelick soil.

Available water capacity is high, and permeability is moderately rapid. Organic matter content of the surface layer is moderate. Surface runoff is slow. The surface layer is very friable and easily tilled throughout a wide range of moisture content.

Almost all of the acreage of this soil is used intensively for corn and soybeans. A few areas are used for small grain, grasses and legumes for forage, and woodland. This soil has good potential for crops and poor potential for sanitary facilities and building sites.

This soil is well suited to corn, soybeans, and small grain. Droughtiness in late summer and occasional flooding in spring are the main limitations. Late planting or replanting is seldom necessary because the occasional flooding is early in spring. The large flood control dams reduce the frequency and severity of flooding. Row crops can be grown most of the time. Minimum tillage, growing winter cover crops, and using crop residue help to maintain and improve organic matter content and maintain good tilth.

This soil is well suited to grasses and legumes for forage. It is especially well suited to deep rooted legumes such as alfalfa. This soil is slightly limited by the hazard of occasional flooding in spring and by droughtiness in late summer. If this soil is used for pasture, the major concerns of management are overgrazing or grazing when the soil is wet. Grazing when the soil is wet causes surface compaction and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, but few areas are in woodland. This soil is moderately limited by plant competition. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling.

This soil has severe limitations for building sites, septic tank absorption fields, and local roads and streets because it is subject to occasional flooding. It is generally unsuitable for building sites.

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

Tr—Treaty silt loam. This soil is nearly level, deep, and poorly drained. It is in slight depressions on broad, slightly undulating till plains. It is frequently ponded by runoff from adjacent higher lying areas. Areas are irregularly shaped and range from 3 to 300 acres in size.

In a typical profile the surface layer is very dark gray silt loam about 12 inches thick. The subsoil is about 33 inches thick. The upper part is gray, mottled, firm silty clay loam, and the lower part is light olive brown, mottled, friable loam. The underlying material, to a depth of 60 inches, is calcareous, olive brown, mottled, friable loam. In some areas the dark surface layer is less than 10 inches thick. In places a few inches of stratification is above the calcareous underlying glacial till. In many areas the silt is less than 2 feet thick over the loamy glacial till.

Included with this soil in mapping are many, small, irregularly shaped and narrow areas of Fincastle soils on slight rises. A few areas of well drained Miami soils are included along small drainageways or on small mounds. These soils dry out more quickly in the spring than the Treaty soil. Some mapped areas contain small wet areas.

Available water capacity is high, and permeability is moderate. The organic matter content of the surface layer is high. Surface runoff is very slow. The water table is between the surface and a depth of 1 foot during a significant part of the year and restricts the depth to which plant roots penetrate. Clods easily form if this soil is plowed when wet. Clods are difficult to break down into a friable seedbed.

Most of the acreage of soil is farmed. Most areas are used for corn and soybeans. A few areas are used for hay, pasture, and woodland. If adequately drained, this soil has good potential for crops. It has poor potential for sanitary facilities and building sites.

This soil is well suited to corn and soybeans. Wetness is the main limitation in use and management of this soil. If this soil is adequately drained, row crops can be grown most of the time. Minimum tillage, using crop residue, and growing cover crops help to maintain and improve organic matter content and maintain good tilth.

This soil is generally well suited to grasses and legumes for hay or pasture. It is poorly suited to deep rooted legumes. Frost heaving, a high water table, and moderate permeability restrict downward movement of roots and water. If this soil is used for pasture, the major concerns of management are grazing when the soil is too wet and overgrazing. Grazing when the soil is wet causes surface compaction and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to trees, but only a few areas are in woodland. Most wooded areas are grazed. This soil has a prolonged seasonal high water table that delays harvest. Trees that tolerate wetness are favored in stands. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling.

This soil has severe limitations for building sites and septic tank absorption fields because it is wet and subject to brief flooding. Dwellings and small buildings should be constructed without basements. The high water table can be lowered and the frequency and duration of flooding reduced by an adequate drainage system. A central sewage system and storm sewers are usually needed. Local roads and streets are also subject to wetness and brief flooding. Strengthening the base with suitable material reduces frost action, and excess water can be removed by ditches.

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

Wh—Washtenaw silt loam. This soil is nearly level, deep, and very poorly drained. It is in minor drainageways and at the base of slopes around deep depressions. It is frequently flooded. This soil is in long, narrow areas along drainageways and on fans and in narrow areas at the base of slopes. Areas range from 3 to 20 acres in size.

In a typical profile the surface layer is dark grayish brown silt loam about 8 inches thick. Below this, to a depth of 23 inches, is dark grayish brown silt loam. The buried surface layer is very dark gray clay loam about 9 inches thick. The buried subsoil is mottled, firm clay loam 38 inches thick. The upper part is dark gray, the next part is dark grayish brown, and the lower part is yellowish brown. The underlying material, to a depth of 75 inches, is brown, friable loam. In some areas the dark grayish brown overwash is less than 20 inches thick.

Included with this soil in mapping are many, small, irregularly shaped areas of very poorly drained Brookston, Pewamo, and Rensselaer soils. These soils usually stay wet longer in spring and are more difficult to plow than the Washtenaw soil. Also included are small areas of very poorly drained Houghton and Palms soils slightly lower in elevation. These soils are often ponded long enough to delay plowing or destroy cultivated crops in spring. A few small areas are ponded for long periods.

Available water capacity is high, and permeability is moderately slow. The organic matter content of the surface layer is moderate. Surface runoff is very slow. Some areas are ponded. The water table is between the surface and a depth of 1 foot in winter and spring and restricts the depth to which plant roots penetrate. The surface layer is friable and is easily tilled throughout a wide range of moisture content. The surface tends to crust or puddle after hard rains.

Most of the acreage of this soil is farmed. Most areas are used for corn and soybeans. A few areas are used for small grain, grasses and legumes for forage, and woodland. If adequately drained, this soil has good potential for crops. It has poor potential for sanitary facilities and building sites.

This soil is well suited to corn and soybeans. Wetness is the main limitation. If this soil is adequately drained, row crops can be grown most of the time. Minimum tillage, using crop residue, and growing cover crops help to maintain and improve organic matter content and maintain good tilth.

This soil is generally well suited to grasses and legumes for hay or pasture. It is poorly suited to deep rooted legumes because a high water table restricts downward movement of roots and water. If this soil is used for pasture, the major concerns of management are grazing when the soil is too wet and overgrazing. Grazing when the soil is wet causes surface compaction and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to trees, but only a few areas are in woodland. Most wooded areas are grazed. This soil has a prolonged seasonal high water table that delays harvest. Trees that tolerate wetness are favored in stands. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling.

This soil has severe limitations for building sites, septic tank absorption fields, and local roads because it is wet and subject to brief flooding. Dwellings and small buildings should be constructed without basements. The high water table of this soil can be lowered and the frequency and duration of flooding reduced by an adequate drainage system. A central sewage system and storm sewers are usually needed. Strengthening the base for local streets and roads with suitable material reduces frost action, and excess water can be removed by ditches.

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

WsB—Wawasee sandy loam, 2 to 6 percent slopes. This soil is gently sloping, deep, and well drained. It is on knolls and side slopes around depressions and along drainageways in the undulating upland till plains and moraines. The slopes are short. Most areas are irregularly shaped, but many are elongated. They range from 3 to 25 acres in size.

In a typical profile the surface layer is dark grayish brown sandy loam about 7 inches thick. The subsurface layer is pale brown sandy loam about 2 inches thick. The subsoil is about 27 inches thick. The upper part is yellowish brown, friable sandy loam; the middle part is yellowish brown, firm loam; and the lower part is yellowish brown, firm and friable loam. The underlying material, to a depth of 60 inches, is light yellowish brown loam.

Included with this soil in mapping are areas of somewhat poorly drained Crosier and Aubbeenaubbee soils in small flat areas or minor drainageways. Also included are a few narrow areas of Brookston soils in drainageways or at the base of side slopes. These soils dry out more slowly in spring than the Wawasee soil and generally have adequate soil moisture for crop growth during summer. Also included are many areas of Metea soils. Some narrow areas of soils along drainageways have slopes of more than 6 percent; these soils dry out more quickly in spring than the Wawasee soil and by summer often lack sufficient soil moisture for crop growth.

Available water capacity is high, and permeability is moderate. The organic matter content is moderate. Surface runoff is medium. The surface layer is very friable and easily tilled throughout a wide range of moisture content.

Most of the acreage of this soil is farmed. Most areas are used for corn, soybeans, and small grain. Some areas are used for hay or pasture, and a few areas are used for woodland. This soil has good potential for crops and sanitary facilities and fair potential for building sites.

This soil is well suited to corn, soybeans, and small grain. Erosion is the main hazard, and droughtiness in late summer is a slight limitation. Conservation practices are needed to control erosion and surface runoff if cultivated crops are grown (fig. 8). Crop rotation, minimum tillage, contour farming, grassed waterways, and grade stabilization structures help to prevent excessive soil loss. Using crop residue and growing cover crops and green manure crops help to control erosion, improve moisture retention, and improve and maintain tilth and organic matter content of this soil.

This soil is well suited to grasses and legumes for hay and pasture. Hay and pasture are effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, but only a few areas remain in woodland. Most wooded areas have been grazed. This soil is moderately limited by plant competition. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling. Woodland management also includes excluding livestock, harvesting mature trees, and saving desired seed trees.

This soil has moderate limitations for building sites. Foundations and footings should be designed to prevent structural damage caused by low strength and shrinking and swelling. This soil has only slight limitations for septic tank absorption fields. Strengthening the base for local roads and streets with more suitable material compensates for the frost action and low strength.

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

WsC—Wawasee sandy loam, 6 to 12 percent slopes. This soil is moderately sloping, deep, and well drained. It is on sides of moderately deep to deep drainageways in upland till plains and moraines. The slopes are short. Most areas are long and narrow or irregularly shaped. They range from 3 to 20 acres in size.

In a typical profile the surface layer is dark grayish brown sandy loam about 9 inches thick. The subsoil is about 28 inches thick. The upper part is yellowish brown, friable sandy loam; the middle part is yellowish brown, firm loam; and the lower part is yellowish brown, friable loam. The underlying material, to a depth of 60 inches, is light yellowish brown loam. The depth to calcareous loam till varies within short horizontal distances, and many spots are calcareous at a depth of less than 24 inches.

Included with this soil in mapping are small areas of Wawasee loam. Seedbed preparation is more difficult on this soil and it dries out more slowly in spring. Also included are some small areas of Metea soils. Some narrow areas along drainageways have slopes of more than 12 percent or of less than 6 percent.

Available water capacity is high, and permeability is moderate. The organic matter content of the surface layer is moderate. Surface runoff is medium. The surface layer is very friable and easily tilled throughout a wide range of moisture content.

Most of the acreage of this soil is farmed. Most areas are used for corn, soybeans, and small grain in rotation.

Some areas are used for hay and pasture, and a few areas are used for woodland. This soil has fair potential for crops and good potential for hay and pasture. It has fair potential for sanitary facilities and building sites.

This soil is suited to corn, soybeans, and small grain. Erosion is the main hazard and droughtiness in late summer is a limitation. Conservation practices are needed to control erosion and surface runoff if cultivated crops are grown. Crop rotation, minimum tillage, contour farming, grassed waterways, and grade stabilization structures help to prevent excessive soil loss. Using crop residue and growing cover crops and green manure crops help to control erosion, improve moisture retention, and improve and maintain tilth and organic matter content of this soil.

This soil is well suited to grasses and legumes for hay and pasture. Hay and pasture are effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, but only a few areas remain in woodland. Most wooded areas have been grazed. This soil is moderately limited by plant competition. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling. Woodland management includes excluding livestock, harvesting mature trees, and saving desired seed trees.

This soil has moderate limitations for building sites because of slope. Grading the area or cutting and filling to modify the slope or designing the project to complement the slope overcomes the limitation. This soil has moderate limitations for septic tank absorption fields because of slope. The absorption field can be designed to operate properly on these slopes. Strengthening the base for local streets and roads with suitable material compensates for frost action and low strength.

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

WsC3—Wawasee loam, 6 to 12 percent slopes, severely eroded. This soil is moderately sloping, deep, and well drained. It is on sides of moderately deep to deep drainageways on upland till plains and moraines. The slopes are short. Most areas are long and narrow or irregularly shaped and range from 3 to 20 acres in size.

In a typical profile the surface layer is dark grayish brown loam about 6 inches thick. The subsoil is yellowish brown loam about 24 inches thick. The upper part is firm, and the lower part is friable. The underlying material, to a depth of 60 inches, is light yellowish brown loam. In places the subsoil is thinner and carbonates are above a depth of 24 inches. The depth to calcareous loam till varies greatly within short horizontal distances, and many spots are calcareous at a depth of less than 24 inches.

Included with this soil in mapping are areas of Wawasee sandy loam. Seedbed preparation is less difficult on this soil. Some narrow strips along drainageways have slopes of more than 12 percent or less than 6 percent.

Available water capacity is high, and permeability is moderate. The organic matter content of the surface layer is moderate. Surface runoff is rapid. The surface layer is firm, and clods form if the soil is plowed when too wet.

Most of the acreage of this soil is farmed. Most areas are used for corn, soybeans, and small grain in rotation. Some areas are used for hay or pasture. This soil has poor potential for crops and fair potential for hay and pasture. It has fair potential for sanitary facilities and building sites.

This soil is poorly suited to corn, soybeans, and small grain. Erosion is the main hazard, and droughtiness in late summer is a limitation. Conservation practices are needed to control erosion and surface runoff if cultivated crops are grown. Crop rotation, minimum tillage, contour farming, grassed waterways, or grade stabilization structures help to prevent excessive soil loss. Using crop residue and growing cover crops and green manure crops help to control erosion, improve moisture retention, and improve and maintain tilth and organic matter content of this soil.

This soil is suited to grasses and legumes for hay and pasture. Hay and pasture are effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Stocking at proper rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, but few areas remain in woodland. Most wooded areas have been grazed. This soil is moderately limited by plant competition. Seedlings survive and grow well if competing vegetation is controlled. Unwanted trees and shrubs can be controlled or removed by site preparation or by spraying, cutting, or girdling. Woodland management also includes excluding livestock, harvesting mature trees, and saving desired seed trees.

This soil has moderate limitations for building sites because of slope. Grading the area or cutting and filling to modify the slope or designing the area to complement the slope overcomes the limitation. This soil has moderate limitations for septic tank absorption fields because of slope. The absorption field can be designed to function properly on these slopes, or a central sewage system can be used. Strengthening the base for local roads and streets with more suitable material compensates for low strength and frost action.

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

WsD3—Wawasee loam, 12 to 18 percent slopes, severely eroded. This soil is strongly sloping, deep, and well drained. It is on sides of deep drainageways in the upland till plains and moraines. Slopes are short. Most areas are irregularly shaped or elongated and range from 3 to 30 acres in size.

In a typical profile the surface layer is brown loam about 6 inches thick. The subsoil is yellowish brown, firm loam about 20 inches thick. The underlying material, to a depth of 60 inches, is yellowish brown loam. In small areas the surface layer is grayish brown sandy loam that is friable and easy to plow and dries out sooner in spring. In small areas the underlying material has been mixed with the subsoil by plowing and the plow layer is yellowish brown loam. It is cloddy and carbonates are present. In most places the depth to the calcareous underlying material varies within short distances, and many spots are calcareous at a depth of less than 25 inches.

Included with this soil in mapping are a few areas of steep and very steep Hennepin soils bordering major drainageways. Also included are small areas, bordering major drainageways, that have slopes greater than 18 percent and are small areas, near the top of the slope, that have slopes of less than 12 percent.

Available water capacity is high, and permeability is moderate. The organic matter content of the surface layer is moderate. Surface runoff is very rapid. This soil is difficult to plow, and clods form if the soil is plowed when too wet. The clods are difficult to break down into a friable seedbed.

Most of the acreage of this soil is used for grasses and legumes for pasture or hay (fig. 9). Some areas are used for corn, soybeans, or small grain. This soil has poor potential for crops and fair to poor potential for sanitary facilities and building sites. It has fair potential for pasture.

This soil is generally unsuitable for corn, soybeans, or grass grain because of the very severe hazard of further erosion. Small grain is occasionally grown so that stands of grasses and legumes can be reestablished. Minimum tillage, diversions, grassed waterways, and using crop residue help to prevent excessive soil loss. Growing of grasses and legumes most of the time is most effective in reducing surface runoff and controlling erosion.

This soil is suited to grasses and legumes for hay and pasture. Hay and pasture are effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Stocking at proper rates, pasture renovation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, and a few areas are in small woodlots that are generally grazed. This soil is moderately limited by plant competition. Seedlings survive and grow well if competing vegetation is controlled and livestock are excluded. Unwanted trees and shrubs can be removed by site preparation or by spraying, cutting, or girdling.

The soil has severe limitations for building sites because of the steep slope. Cutting and filling or designing the area to complement the slope reduces the limitation. The absorption field can be designed to function properly on the slope, or a central sewage system can be used. The base for local roads and streets can be strengthened with more suitable material.

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

Use and management of the soils

The soil survey is a detailed inventory and evaluation of the most basic resource of the survey area—the soil. It is useful in adjusting land use, including urbanization, to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in uses of the land.

While a soil survey is in progress, soil scientists, conservationists, engineers, and others keep extensive notes about the nature of the soils and about unique aspects of behavior of the soils. These notes include data on erosion, drought damage to specific crops, yield estimates, flooding, the functioning of septic tank disposal systems, and other factors affecting the productivity, potential, and limitations of the soils under various uses and management. In this way, field experience and measured data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section is useful in planning use and management of soils for crops and pasture, and woodland, as sites for buildings, highways and other transportation systems, sanitary facilities, and parks and other recreation facilities, and for wildlife habitat. From the data presented, the potential of each soil for specified land uses can be determined, soil limitations to these land uses can be identified, and costly failures in houses and other structures, caused by unfavorable soil properties, can be avoided. A site where soil properties are favorable can be selected, or practices that will overcome the soil limitations can be planned.

Planners and others using the soil survey can evaluate the impact of specific land uses on the overall productivity of the survey area or other broad planning area and on the environment. Productivity and the environment are closely related to the nature of the soil. Plans should maintain or create a land-use pattern in harmony with the natural soil.

Contractors can find information that is useful in locating sources of sand and gravel, roadfill, and topsoil. Other information indicates the presence of bedrock, wetness, or very firm soil horizons that cause difficulty in excavation.

Health officials, highway officials, engineers, and many other specialists also can find useful information in this soil survey. The safe disposal of wastes, for example, is closely related to properties of the soil. Pavements, sidewalks, campsites, playgrounds, lawns, and trees and shrubs are influenced by the nature of the soil.

Crops and pasture

The major management concerns in the use of the soils for crops and pasture are described in this section. In addition, the crops or pasture plants best suited to the soil, including some not commonly grown in the survey area, are discussed; 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 presented for each soil.

This section provides information about the overall agricultural potential of the survey area and about the management practices that are needed. The information is useful to equipment dealers, land improvement contractors, fertilizer companies, processing companies, planners, conservationists, and others. For each kind of soil, information about management is presented in the section "Soil maps for detailed planning." Planners of management systems for individual fields or farms should also consider the detailed information given in the description of each soil.

More than 201,610 acres in the survey area was used for crops and pasture in 1967. Of this, 29,916 acres was used for permanent pasture; 118,608 acres for row crops, mainly corn and soybeans; 23,174 acres for close-grown crops, mainly wheat and oats; and 17,907 acres for rotation hay and pasture. The rest was idle or used for conservation purposes (*3*).

The potential of the soils in Miami County for increased production of food is fair. About 11,798 acres of potentially good cropland is currently used as woodland and about 16,222 acres as pasture. In addition to the reserve productive capacity represented by this land, food production could also be increased considerably by extending the latest crop production technology to all cropland in the county. This soil survey can greatly facilitate the application of such technology.

Acreage in crops and pasture has very gradually been decreasing as more land is used for urban development. In 1967, about 11,168 acres of urban and built up land was in the county. This figure has been growing at the rate of about 130 acres per year. The use of this soil survey to help make land use decisions that will influence the future role of farming in the county is discussed in the section "General soil map for broad land use planning."

Soil wetness (fig. 10) is the major problem on about 50 percent of the cropland and pasture in Miami County. Most of the poorly drained and very poory drained soils such as Brookston, Treaty, Pewamo, Rensselaer, Gilford, Palms, Sloan, and Houghton soils are satisfactorily drained for crops. Many areas of Houghton, Palms, Rensselaer, Gilford, Pewamo, and Brookston soils in the northern part of the county need additional drainage to be used for crops. They are depressional areas; however, drainage ditches to a suitable outlet would have to be deep and extend for great distances.

Unless artificially drained, the somewhat poorly drained soils are so wet that crops are damaged during most years. In this category are Crosier, Fincastle, Blount, Sleeth, Shoals, and Aubbeenaubbee soils, which make up about 57,900 acres.

Miami and Morley soils have good natural drainage most of the year, but they tend to dry slowly after rains. Small areas of wetter soils along drainageways and in swales are commonly included in areas of these soils, especially where slope is 2 to 6 percent. Artificial drainage is needed for crops in some of these wetter areas.

The design of both surface and subsurface drainage systems varies with the kind of soil. A combination of surface drainage and tile drainage is needed in most areas of the very poorly drained soils used intensively for row crops. Drains have to be more closely spaced in slowly permeable soils than in soils that are more permeable. Permeability is moderately slow in Pewamo soils. Finding adequate outlets for tile drainage is difficult in many areas of Brookston, Pewamo, Rensselaer, Gilford, Palms, and Houghton soils in the northern part of the county.

Organic soils oxidize and subside when drained; therefore, special drainage systems are needed to control the depth and the period of drainage. Keeping the water table at the level required by crops during the growing season and raising it to the surface during other parts of the year minimizes the oxidation and subsidence of organic soils.

Information on drainage design for each kind of soil is available from local offices of the Soil Conservation Service.

Soil erosion (fig. 11) is the major soil problem on about 39 percent of the cropland in Miami County. If slope is more than 2 percent, erosion is a hazard.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils with a clayey subsoil, such as Morley, Blount, and Miami soils, and on soils with a layer in or below the subsoil that limits the depth of the root zone, such as the bedrock in Milton soils. Erosion also reduces productivity on soils that tend to be droughty, such as Fox and Ockley soils. Second, soil erosion results in sediment entering streams. Controlling erosion minimizes the pollution of streams by sediment and improves water quality for municipal use, for recreation, and for fish and wildlife.

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

Erosion control practices provide surface cover, reduce runoff, and increase infiltration. A cropping system that keeps plant cover on the soil for extended periods can hold soil erosion losses to amounts that will not reduce the capacity of the soils to produce. On livestock farms, which require pasture and hay, the legume and grass forage crops in the cropping system reduce erosion on sloping land and also provide nitrogen and improve tilth for the following crop.

On many sloping soils in Miami County, slopes are so short and irregular that contour tillage or terracing is not practical. On these soils, cropping systems that provide substantial plant cover are required to control erosion unless minimum tillage is practiced. Minimizing tillage and leaving crop residue on the surface help to increase infiltration and reduce runoff and erosion. These practices can be adapted to most soils in the survey area, but are more difficult to use successfully on the eroded soils and on the soils that have a clayey surface layer, such as Pewamo soils and severely eroded Miami and Morley soils. No-tillage for corn, which is increasingly common, reduces erosion on sloping land and can be adapted to most soils in the survey area. It is more difficult to practice successfully, however, on soils that have a clayey surface layer.

Diversions and parallel tile outlet terraces are used to shorten the length of the slope and reduce sheet, rill, and gully erosion. They are most practical on deep, well drained soils that are highly susceptible to erosion. Terracing reduces soil loss and the associated loss of fertilizer elements; reduces the damage done to crops and watercourses by sediment; reduces the need for grassed waterways, which take productive land out of row crops; and makes it easier to farm on the contour, which reduces the use of fuel and reduces the amount of pesticides entering watercourses. Some of the Miami soils are suitable for terraces. Soils that have a heavy clayey subsoil are less suitable for terraces and diversions.

Grassed waterways are needed in many areas of sloping soils such as Miami, Morley, and Fox soils. In addition many areas of Fincastle, Treaty, Blount, and Pewamo soils should have waterways where a large watershed drains across them. Tile drainage is usually needed beneath these waterways so that wetness is relieved and the waterways can be crossed with farm machinery. In addition, many areas of Miami and Morley soils are seepy along drainageways, and tile should be installed beneath the waterways.

Because of the large number of open ditches in the county, many grade stabilization structures are needed. These structures reduce erosion where surface water drains into an open ditch. Also, structures are occasionally needed in open ditches where there is too much grade and where the water moves so rapidly that it erodes the sides and bottom of some channels.

Soil blowing is a hazard on Houghton and Palms soils when they are drained. It is also a hazard on the well drained Metea, Chelsea, and some Oshtemo soils. Soil blowing can damage these soils in a few hours if winds are strong and the soils are dry and bare of vegetation or surface mulch. Maintaining plant cover, surface mulch, or a rough surface through proper tillage minimizes soil blowing on these soils. Windbreaks of adapted shrubs are also effective in reducing wind erosion. Soil blowing also occurs on the dark mineral soils when they are barren. Soils that are plowed in fall are very susceptible to wind erosion the following spring.

Soil droughtiness is a major hazard on approximately 19,500 acres of cropland and pasture in Miami County. Fox, Oshtemo, and Chelsea soils, for example, have a drought hazard. Most areas of these soils are along the Eel River terrace or in the sandy hills in the northern part of the county.

Crop production on soils with a drought hazard depends largely on adequate amount and good distribution of precipitation over the growing season. During years with lower than average rainfall or poor distribution, crop production is greatly reduced. In years with greater than average rainfall and good distribution, crop production is increased.

Several methods can be used to help overcome the drought limitation on these soils during years with lower than average rainfall or poor distribution of rainfall. Irrigation, which has been used to a very slight degree, can increase crop production during these years. Other, more common practices include crop residue management, green manure crops, and use of barnyard manure to maintain or increase the organic matter content of the soil. Planting early and using early maturing varieties of corn and soybeans are also precautions against drought, as is weed control.

Soil fertility is naturally low or moderate in most soils of the uplands and terraces in the survey area. The soils on flood plains, such as Gessie, Sloan, and Shoals soils, are neutral or mildly alkaline and are naturally higher in plant nutrients than most upland and terrace soils. The very poorly drained soils such as Brookston, Patton, Pewamo, Rensselaer, Sloan, Houghton, and Palms soils are in slight depressions and receive runoff from adjacent uplands. They normally are slightly acid or neutral.

Most upland and terrace soils are naturally strongly acid or medium acid. They usually require applications of ground limestone, which raise the pH level enough for good growth of alfalfa and other crops that grow only on nearly neutral soils. Available phosphorus and potash levels are naturally low in most of these soils. On all soils, the addition of lime and fertilizer should be based on the results of soil tests, on the needs of the crop, and on the expected yield. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime to apply.

Soil tilth is an important factor in the germination of seeds and in the infiltration of water into the soil. Soils with good tilth are granular and porous.

Many of the soils used for crops in the survey areas have a silt loam surface layer that is moderately dark in color and moderate in organic matter content. Generally the structure of these soils is moderate to weak, and intense rainfall causes the formation of a crust on the surface. The crust in some areas is hard and impervious to water when dry. Once a hard crust forms, infiltration is reduced and runoff is increased. Regular additions of crop residue, manure, and other organic material improve soil structure and reduce crust formation.

Fall plowing is generally not a good practice on the moderately dark colored soils that have a silt loam surface layer, because a crust forms during winter and spring. Many of the soils are nearly as dense and hard at planting time as they were before fall plowing. Also, about 39 percent of the cropland consists of sloping soils that are subject to damaging erosion if they are plowed in fall.

The dark colored Brookston, Patton, Pewamo, Treaty, Milford, and Sloan soils have a high percentage of clay. Tilth is a problem because the soils often stay wet until late in spring. If plowed when wet, these soils tend to be very cloddy when dry, and a good seedbed is difficult to prepare. Fall plowing generally results in good tilth in spring.

A *plowpan* is an important factor in rooting depth and water percolation through the soil. Soils with a plowpan stay wet longer in spring. Furthermore, the crops are more susceptible to drought stress earlier in the growing season because the rooting system is shallow.

A plowpan is a firm, dense, compacted layer 3 to 6 inches thick immediately under the plow layer. Plowpans are very common and occur over a wide variety of soil conditions in Miami County. They are more common and more pronounced in the somewhat poorly drained and very poorly drained soils such as Fincastle, Blount, Crosier, Treaty, Pewamo, Brookston, and Houghton soils.

Plowing at the proper moisture content, varying the plow depth from year to year, and using minimum tillage prevent plowpans from increasing in thickness and density. Freezing and thawing, chisel plowing, and deep rooted legumes help to break up the plowpan, improve drainage, and increase rooting depth.

Field crops suited to the soils and climate of the survey area include many that are not now commonly grown. Corn and soybeans are the main row crops.

Wheat and oats are the common close-growing crops. Rye could be grown, and grass seed could be produced from bromegrass, fescue, redtop, and bluegrass.

Special crops are very limited in the survey area. Only a small acreage is used for vegetables and small fruits. Deep soils that have good natural drainage and that warm early in spring are especially well suited to many vegetables and small fruits. In the survey area these are Ockley, Fox, and Oshtemo soils that have slopes of less than 6 percent, and they total about 14,895 acres. Fox and Oshtemo soils need irrigation for optimum production. Crops can generally be planted and harvested earlier on these soils than on the other soils in the survey area.

If adequately drained, the muck soils in the county are well suited to a wide range of vegetable crops. Houghton and Palms muck make up about 5,030 acres in the survey area.

Most of the well-drained soils in the survey area are suitable for orchards and nursery plants. Soils in low positions where frost is frequent and air drainage is poor, however, generally are poorly suited to early vegetables, small fruits, and orchards.

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

Yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. Absence of an estimated yield indicates that the crop is not suited to or not commonly grown on the soil.

The estimated yields were based mainly on the experience and records of farmers, conservationists, and extension agents. Results of field trials and demonstrations and available yield data from nearby counties were also considered.

The yields were estimated assuming that the latest soil and crop management practices were used. Hay and pasture yields were estimated for the most productive varieties of grasses and legumes suited to the climate and the soil. A few farmers may be obtaining average yields higher than those shown in table 6.

The management needed to achieve the indicated yields of the various crops depends on the kind of soil and the crop. Such management provides drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate tillage practices, including time of tillage and seedbed preparation and tilling when soil moisture is favorable; 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 residues, barnyard manure, and green-manure crops; harvesting crops with the smallest possible loss; and timeliness of all fieldwork.

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

Capability classes and subclasses

Capability classes and subclasses show, in a general way, the suitability of soils for most kinds of field crops. The soils are classed according to their limitations when they are used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops that require special management. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for forest trees or for engineering purposes.

In Miami County, all kinds of soil are grouped at two levels: capability class, and subclass. The capability class and subclass are defined in the following paragraphs. A survey area may not have soils of all classes.

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 landforms 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 too cold or too 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, though 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 indicated in table 7. All soils in the survey area except those named at a level higher than the series are included. Some of the soils that are well suited to crops and pasture may be in low-intensity use, for example, soils in capability classes I and II. Data in this table can be used to determine the farming potential of such soils.

The capability subclass is identified in the description of each map unit in the section "Soil maps for detailed planning."

Woodland management and productivity

Mitchell G. Hassler, forester, Soil Conservation Service, helped to prepare this section.

Table 8 contains information useful to woodland owners or forest managers planning use of soils for wood crops. Map unit symbols for soils suitable for wood crops are listed, and the ordination (woodland suitability) symbol for each soil is given. All soils bearing the same ordination symbol require the same general kinds of woodland management and have about the same potential productivity.

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

In table 8 the soils are also rated for a number of factors to be considered in management. *Slight, moderate,* and *severe* are used to indicate the degree of major soil limitations.

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

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

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

Considered in the ratings of *windthrow hazard* are characteristics of the soil that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of *slight* indicates that trees in wooded areas are not expected to be blown down by commonly occurring winds; *moderate*, that some trees are blown down during periods of excessive soil wetness and strong winds; and *severe*, that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

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

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

Windbreaks and environmental plantings

Windbreaks are established to protect livestock, buildings, and yards from wind and snow. Windbreaks also help protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broad-leaved and coniferous species 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 depending on erodibility of the soil. They protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

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

Table 9 shows the height that locally grown trees and shrubs are expected to reach on various kinds of soil in 20 years. The estimates in table 9 based on measurements and observation of established plantings that have been given adequate care, can be used as a guide in planning windbreaks and screens. Additional information about planning windbreaks and screens and the planting and care of trees can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service, from the Division of Forestry, Indiana Department of Natural Resources, or from nurserymen.

Engineering

This section provides information about the use of soils for building sites, sanitary facilities, construction material, and water management. Among those who can benefit from this information are engineers, landowners, community planners, town and city managers, land developers, builders, contractors, and farmers.

The ratings in the engineering tables are based on test data and estimated data in the "Soil properties" section. The ratings were determined jointly by soil scientists and engineers of the Soil Conservation Service using known relationships between the soil properties and the behavior of soils in various engineering uses.

Among the soil properties and site conditions identified by a soil survey and used in determining the ratings in this section were grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock that is within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure or aggregation, in-place soil density, and geologic origin of the soil material. Where pertinent, data about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of absorbed cations were also considered.

On the basis of information assembled about soil properties, ranges of values can be estimated for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, shear strength, compressibility, slope stability, and other factors of expected soil behavior in engineering uses. As appropriate, these values can be applied to each major horizon of each soil or to the entire profile.

These factors of soil behavior affect construction and maintenance of roads, airport runways, pipelines, foundations for small buildings, ponds and small dams, irrigation projects, drainage systems, sewage and refuse disposal systems, and other engineering works. The ranges of values can be used to (1) select potential residential, commercial, industrial, and recreational uses; (2) make preliminary estimates pertinent to construction in a particular area; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for location of sanitary landfills, onsite sewage disposal systems, and other waste disposal facilities; (5) plan detailed onsite investigations of soils and geology; (6) find sources of gravel, sand, clay, and topsoil; (7) plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; (8) relate performance of structures already built to the properties of the kinds of soil on which they are built so that performance of similar structures on the same or a similar soil in other locations can be predicted; and (9) predict the trafficability of soils for cross-country movement of vehicles and construction equipment.

Data presented in this section are useful for land use planning and for choosing alternative practices or general designs that will overcome unfavorable soil properties and minimize soil-related failures. Limitations to the use of these data, however, should be well understood. First, the data are generally not presented for soil material below a depth of 5 or 6 feet. Also, because of the scale of the detailed map in this soil survey, small areas of soils that differ from the dominant soil may be included in mapping. Thus, these data do not eliminate the need for onsite investigations, testing, and analysis by personnel having expertise in the specific use contemplated.

The information is presented mainly in tables. Table 10 shows, for each kind of soil, the degree and kind of limitations for building site development; table 11, for sanitary facilities. Table 13 shows the kind of limitations for water management. Table 12 shows the suitability of each kind of soil as a source of construction materials.

The information in the tables, along with the soil map, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations and to construct interpretive maps for specific uses of land.

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

Building site development

The degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets are indicated in table 10. A *slight* limitation indicates that soil properties generally are favorable for the specified use; any limitation is minor and easily overcome. A *moderate* limitation indicates that soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design. A *severe* limitation indicates that one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required. For some soils rated severe, such costly measures may not be feasible.

Shallow excavations are made for pipelines, sewerlines, communications and power transmission lines, basements, open ditches, and cemeteries. Such digging or trenching is influenced by soil wetness caused by a seasonal high water table; the texture and consistence of soils; the tendency of soils to cave in or slough; and the presence of very firm, dense soil layers, bedrock, or large stones. In addition, excavations are affected by slope of the soil and the probability of flooding. Ratings do not apply to soil horizons below a depth of 6 feet unless otherwise noted.

In the soil series descriptions, the consistence of each soil horizon is given, and the presence of very firm or extremely firm horizons, usually difficult to excavate, is indicated.

Dwellings and *small commercial buildings* referred to in table 10 are built on undisturbed soil and have foundation loads of a dwelling no more than three stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, soils should be sufficiently stable that cracking or subsidence of the structure from settling or shear failure of the foundation does not occur. These ratings were determined from estimates of the shear strength, compressibility, and shrink-swell potential of the soil. Soil texture, plasticity and in-place density, soil wetness, and depth to a seasonal high water table were also considered. Soil wetness and depth to a seasonal high water table indicate potential difficulty in providing adequate drainage for basements, lawns, and gardens. Depth to bedrock, slope, and large stones in or on the soil are also important considerations in the choice of sites for these structures and were considered in determining the ratings. Susceptibility to flooding is a serious hazard.

Local roads and streets referred to in table 10 have an all-weather surface that can carry light to medium traffic all year. They consist of a subgrade of the underlying soil material; a base of gravel, crushed rock fragments, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep.

The load supporting capacity and the stability of the soil as well as the quantity and workability of fill material available are important in design and construction of roads and streets. The classifications of the soil and the soil texture, density, shrink-swell potential, and potential frost action are indicators of the traffic supporting capacity used in making the ratings. Soil wetness, flooding, slope, depth to hard rock or very compact layers, and content of large stones affect stability and ease of excavation.

Sanitary facilities

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons, and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that affect ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table 11 shows the degree and kind of limitations of each soil for such uses and for use of the soil as daily cover for landfills. It is important to observe local ordinances and regulations.

If the degree of soil limitation is expressed as *slight*, soils are generally favorable for the specified use and limitations are minor and easily overcome; if *moderate*, soil properties or site features are unfavorable for the specified use, but limitations can be overcome by special planning and design; and if *severe*, soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special designs, or intensive maintenance is required. Soil suitability is rated by the terms *good*, *fair*, or *poor*, which, respectively, mean about the same as the terms *slight*, *moderate*, and *severe*.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. Only the soil horizons between depths of 18 and 72 inches are evaluated for this use. The soil properties and site features considered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that affect absorption of the effluent are permeability, depth to seasonal high water table, depth to bedrock, and susceptibility to flooding. Stones, boulders, and shallowness to bedrock interfere with installation. Excessive slope can cause lateral seepage and surfacing of the effluent. Also, soil erosion and soil slippage are hazards if absorption fields are installed on sloping soils.

In some soils, loose sand and gravel or fractured bedrock is less than 4 feet below the tile lines. In these soils the absorption field does not adequately filter the effluent, and ground water in the area may be contaminated.

On many of the soils that have moderate or severe limitations for use as septic tank absorption fields, a system to lower the seasonal water table can be installed or the size of the absorption field can be increased so that performance is satisfactory.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons have a nearly level floor and cut slopes or embankments of compacted soil material. Aerobic lagoons generally are designed to hold 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. Soils that are very high in content of organic matter and those that have cobbles, stones, or boulders are not suitable. Unless the soil has very slow permeability, contamination of ground water is a hazard where the seasonal high water table is above the level of the lagoon floor. In soils where the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce the lagoon's capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the suitability of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soil material affect the performance of embankments.

Sanitary landfill is a method of disposing of solid waste by placing refuse in successive layers either in excavated trenches or on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil material. Landfill areas are subject to heavy vehicular traffic. Risk of polluting ground water and trafficability affect the suitability of a soil for this use. The best soils have a loamy or silty texture, have moderate to slow permeability, are deep to a seasonal water table, and are not subject to flooding. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability, which might allow noxious liquids to contaminate ground water. Soil wetness can be a limitation, because operating heavy equipment on a wet soil is difficult. Seepage into the refuse increases the risk of pollution of ground water.

Ease of excavation affects the suitability of a soil for the trench type of landfill. A suitable soil is deep to bedrock and free of large stones and boulders. If the seasonal water table is high, water will seep into trenches.

Unless otherwise stated, the limitations in table 11 apply only to the soil material within a depth of about 6 feet. If the trench is deeper, a limitation of slight or moderate may not be valid. Site investigation is needed before a site is selected.

Daily cover for landfill should be soil that is easy to excavate and spread over the compacted fill in wet and dry periods. Soils that are loamy or silty and free of stones or boulders are better than other soils. Clayey soils may be sticky and difficult to spread; sandy soils may be subject to soil blowing.

The soils selected for final cover of landfills should be suitable for growing plants. Of all the horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants. Thus, for either the area- or trench-type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

Where it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material available and depth to a seasonal high water table in soils surrounding the sites should be evaluated. Other factors to be evaluated are those that affect reclamation of the borrow areas. These factors include slope, erodibility, and potential for plant growth.

Construction materials

The suitability of each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 12 by ratings of good, fair, or poor. The texture, thickness, and organic-matter content of each soil horizon are important factors in rating soils for use as construction materials. Each soil is evaluated to the depth observed, generally about 6 feet.

Roadfill is soil material used in embankments for roads. Soils are evaluated as a source of roadfill for low embankments, which generally are less than 6 feet high and less exacting in design than high embankments. The ratings reflect the ease of excavating and working the material and the expected performance of the material where it has been compacted and adequately drained. The performance of soil after it is stabilized with lime or cement is not considered in the ratings, but information about some of the soil properties that influence such performance is given in the descriptions of the soil series.

The ratings apply to the soil material between the A horizon and a depth of 5 to 6 feet. It is assumed that soil horizons will be mixed during excavation and spreading. Many soils have horizons of contrasting suitability within their profile. The estimated engineering properties in table 16 provide specific information about the nature of each horizon. This information can help determine the suitability of each horizon for roadfill.

Soils rated *good* are coarse grained. They have low shrink-swell potential, and few cobbles and stones. They are at least moderately well drained and have slopes of 15 percent or less. Soils rated *fair* have a plasticity index of less than 15 and have other limiting features, such as moderate shrink-swell potential, moderately steep slopes, wetness, or many stones. If the thickness of suitable material is less than 3 feet, the entire soil is rated *poor*.

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 12 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 16.

Topsoil is used in areas where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material in preparing a seedbed and by the ability of the soil material to support plantlife. Also considered is the damage that can result at the area from which the topsoil is taken.

The ease of excavation is influenced by the thickness of suitable material, wetness, slope, and amount of stones. The ability of the soil to support plantlife is determined by texture, structure, and the amount of soluble salts or toxic substances. Organic matter in the A1 or Ap horizon greatly increases the absorption and retention of moisture and nutrients. Therefore, the soil material from these horizons should be carefully preserved for later use.

Soils rated *good* have at least 16 inches of friable loamy material at their surface. They are free of stones and cobbles, are low in content of gravel, and have gentle slopes. They are low in soluble salts that can limit or prevent plant growth. They are naturally fertile or respond well to fertilizer. They are not so wet that excavation is difficult during most of the year.

Soils rated *fair* are loose sandy soils or firm loamy or clayey soils in which the suitable material is only 8 to 16 inches thick or soils that have appreciable amounts of gravel, stones, or soluble salt.

Soils rated *poor* are very sandy soils and very firm clayey soils; soils with suitable layers less than 8 inches thick; soils having large amounts of gravel, stones, or soluble salt; steep soils; and poorly drained soils.

Although a rating of *good* is not based entirely on high content of organic matter, a surface horizon is generally preferred for topsoil because of its organic-matter content. This horizon is designated as A1 or Ap in the soil series descriptions. The absorption and retention of moisture and nutrients for plant growth are greatly increased by organic matter.

Water management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 13 soil and site features that affect use are indicated for each kind of soil. This information is significant in planning, installing, and maintaining water-control structures.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have a low seepage potential, which is determined by permeability and the depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material that is resistant to seepage, erosion, and piping and has favorable stability, shrink-swell potential, shear strength, and compaction characteristics. Large stones and organic matter in a soil downgrade the suitability of a soil for use in embankments, dikes, and levees.

Aquifer-fed excavated ponds are bodies of water made by excavating a pit or dugout into a ground-water aquifer. Excluded are ponds that are fed by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Ratings in table 13 are for ponds that are properly designed, located, and constructed. Soil properties and site features that affect aquifer-fed ponds are depth to a permanent water table, permeability of the aquifer, quality of the water, and ease of excavation.

Drainage of soil is affected by such soil properties as permeability; texture; depth to bedrock, hardpan, or other layers that affect the rate of water movement; depth to the water table; slope; stability of ditchbanks; susceptibility to flooding; salinity and alkalinity; and availability of outlets for drainage.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to intercept runoff. They allow water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock, hardpan, or other unfavorable material; large stones; permeability; ease of establishing vegetation; and resistance to water erosion, soil blowing, soil slipping, and piping.

Grassed waterways are constructed to channel runoff to outlets at a nonerosive velocity. Features that affect the use of soils for waterways are slope, permeability, erodibility, wetness, and suitability for permanent vegetation.

Recreation

The soils of the survey area are rated in table 14 according to limitations that affect their suitability for recreation uses (fig. 12). The ratings are based on such restrictive soil features as flooding, wetness, slope, and texture of the surface layer. Not considered in these ratings, but important in evaluating a site, are location and accessibility of the area, size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites available, and either access to public sewerlines or capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degree, for recreation use by the duration and intensity of flooding and the season when flooding occurs. Onsite assessment of height, duration, intensity, and frequency of flooding is essential in planning recreation facilities.

The degree of the limitation of the soils is expressed as slight, moderate, or severe. *Slight* means that the soil properties are generally favorable and that the limitations are minor and easily overcome. *Moderate* means that the 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 14 can be supplemented by information in other parts of this survey. Especially helpful are interpretations for septic tank absorption fields, given in table 11, and interpretations for dwellings without basements and for local roads and streets, given in table 10.

Camp areas require such site preparation as shaping and leveling for 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 for this use have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing camping sites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for use as 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 will 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 or boulders, is firm after rains, and is not dusty when dry. If shaping is required to obtain a uniform grade, the depth of the soil over bedrock or hardpan should be enough to allow necessary grading.

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

Wildlife habitat

Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover, and they affect the construction of water impoundments. The kind and abundance of wildlife that populate an area depend largely on the amount and distribution of food, cover, and water. If any one of these elements is missing, is inadequate, or is inaccessible, wildlife either are scarce or do not inhabit the area.

If the soils have the potential, wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by helping the natural establishment of desirable plants.

In table 15, the soils in the survey area are rated according to their potential to support the main kinds of wildlife habitat in the area. This information can be used in planning for parks, wildlife refuges, nature study areas, and other developments for wildlife; selecting areas that are suitable for wildlife; selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat; and 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* means that the element of wildlife habitat or the kind of habitat is easily created, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected if the soil is used for the designated purpose. A rating of *fair* means that the element of wildlife habitat or kind of habitat can be created, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* means that limitations are severe for the designated element or kind of wildlife habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* means that restrictions for the element of wildlife habitat or kind of wildlife are very severe, and that unsatisfactory results can be expected. Wildlife habitat is impractical or even impossible to create, improve, or maintain on soils having such a rating.

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

Grain and seed crops are seed-producing annuals used by wildlife. The major soil properties 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, soybeans, and grain sorghum.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted for wildlife food and cover. Major soil properties that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, sericea lespedeza, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and herbs, including weeds, that provide food and cover for wildlife. Major soil properties 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, beggarweed, foxtail, and ironweed.

Hardwood trees and the associated woody understory provide cover for wildlife and produce nuts or other fruit, buds, catkins, twigs, bark, or foliage that wildlife eat. Major soil properties that affect growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of native plants are oak, poplar, cherry, apple, hawthorn, dogwood, hickory, blackberry, and elderberry. Examples of fruit-producing shrubs that are commercially available and suitable for planting on soils rated *good* are bush honeysuckle, autumn-olive, and crabapple.

Coniferous plants are cone-bearing trees, shrubs, or ground cover plants that furnish habitat or supply food in the form of browse, seeds, or fruitlike cones. Soil properties that have a major effect on the growth of coniferous plants 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, exclusive of submerged or floating aquatics. They produce food or cover for wildlife that use wetland as habitat. Major soil properties affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, prairie cordgrass, reed canary grass and rushes, sedges, and reeds.

Shallow water areas are bodies of water that have an average depth of less than 5 feet and that are useful to wildlife. They can be naturally wet areas, or they can be created by dams or levees or by water-control structures in marshes or streams. Major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. The availability of a dependable water supply is important if water areas are to be developed. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The kinds of wildlife habitat are briefly described in the following paragraphs.

Openland habitat consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The kinds of wildlife attracted to these areas include bobwhite quail, doves, pheasant, meadowlark, killdeer, field sparrow, cottontail rabbit, red and gray fox, and woodchuck.

Woodland habitat consists of areas of hardwoods or conifers, or a mixture of both, and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include woodcock, thrushes, woodpeckers, squirrels, red and gray fox, raccoon, and white-tailed deer.

Wetland habitat consists of open, marshy or swampy, shallow water areas where water-tolerant plants grow (fig. 13). Some of the wildlife attracted to such areas are ducks, geese, herons, rails, king fishers, shore birds, muskrat, mink, and beaver.

Soil properties

Extensive data about soil properties are summarized on the following pages. The two main sources of these data are the many thousands of soil borings made during the course of the survey and the laboratory analyses of selected soil samples from typical profiles.

In making soil borings during field mapping, soil scientists can identify several important soil properties. They note the seasonal soil moisture condition or the presence of free water and its depth. For each horizon in the profile, they note the thickness and color of the soil material; the texture, or amount of clay, silt, sand, and gravel or other coarse fragments; the structure, or the natural pattern of cracks and pores in the undisturbed soil; and the consistence of the soil material in place under the existing soil moisture conditions. They record the depth of plant roots, determine the pH or reaction of the soil, and identify any free carbonates.

Samples of soil material are analyzed in the laboratory to verify the field estimates of soil properties and to determine all major properties of key soils, especially properties that cannot be estimated accurately by field observation. Laboratory analyses are not conducted for all soil series in the survey area, but laboratory data for many soil series not tested are available from nearby survey areas.

The available field and laboratory data are summarized in tables. The tables give the estimated range of engineering properties, the engineering classifications, and the physical and chemical properties of each major horizon of each soil in the survey area. They also present data about pertinent soil and water features.

Engineering properties

Table 16 gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area.

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Table 16 gives information for each of these contrasting horizons in a typical profile. *Depth* to the upper and lower boundaries of each horizon is indicated. More information about the range in depth and about other properties in each horizon is given for each soil series in the section "Soil series and morphology."

Texture is described in table 16 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 soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use are the Unified Soil Classification System (Unified) (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO) (*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, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes—eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example, CL-ML.

The *AASHTO* system classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified in one of seven basic groups ranging 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. At the other extreme, in group A-7, are fine-grained soils. Highly organic soils are classified in group A-8 on the basis of visual inspection.

When laboratory data are available, the A-1, A-2, and A-7 groups are further classified as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6.

Also in table 16 the percentage, by weight, of rock fragments more than 3 inches in diameter is estimated for each major horizon. These estimates are determined mainly by observing volume percentage in the field and then converting that, by formula, to weight percentage.

Percentage of the soil material less than 3 inches in diameter that passes each of four sieves (U.S. standard) is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from many borings made during the survey.

Liquid limit and *plasticity index* indicate the effect of water on the strength and consistence of soil. These indexes are used in both the Unified and AASHTO soil classification systems. They are also used as indicators in making general predictions of soil behavior. Range in liquid limit and plasticity index are estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

In some surveys, the estimates are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterburg limits extend a marginal amount across classification boundaries (1 or 2 percent), the classification in the marginal zone is omitted.

Physical and chemical properties

Table 17 shows estimated values for several soil characteristics and features that affect behavior of soils in engineering uses. These estimates are given for each major horizon, at the depths indicated, in the typical pedon of each soil. The estimates are based on field observations and on test data for these and similar soils.

Permeability is estimated on the basis of known relationships among the soil characteristics observed in the field—particularly soil structure, porosity, and gradation or texture—that influence the downward movement of water in the soil. The estimates are for vertical water movement when the soil is saturated. Not considered in the estimates is lateral seepage or such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in planning and designing drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems, and in many other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, soil texture, and soil structure. Shallow-rooted plants are not likely to use the available water from the deeper soil horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems.

Soil reaction is expressed as a range in pH values. The range in pH of each major horizon is based on many field checks. For many soils, the values have been verified by laboratory analyses. Soil reaction is important in selecting the crops, ornamental plants, or other plants to be grown; in evaluating soil amendments for fertility and stabilization; and in evaluating the corrosivity of soils.

Shrink-swell potential depends mainly on the amount and kind of clay in the soil. Laboratory measurements of the swelling of undisturbed clods were made for many soils. For others the swelling was estimated on the basis of the kind and amount of clay in the soil and on measurements of similar soils. The size of the load and the magnitude of the change in soil moisture content also influence the swelling of soils. Shrinking and swelling of some soils can cause damage to building foundations, basement walls, roads, and other structures unless special designs are used. A high shrink-swell potential indicates that special design and added expense may be required if the planned use of the soil will not tolerate large volume changes.

Erosion factors are used to predict the erodibility of a soil and its tolerance to erosion in relation to specific kinds of land use and treatment. The soil erodibility factor (K) is a measure of the susceptibility of the soil to erosion by water. Soils having the highest K values are the most erodible. K values range from 0.10 to 0.64. To estimate annual soil loss per acre, the K value of a soil is modified by factors representing plant cover, grade and length of slope, management practices, and climate. The soil-loss tolerance factor (T) is the maximum rate of soil erosion, whether from rainfall or soil blowing, that can occur without reducing crop production or environmental quality. The rate is expressed in tons of soil loss per acre per year.

Wind erodibility groups are made up of soils that have similar properties that affect their resistance to soil blowing if cultivated. The groups are used to predict the susceptibility of soil to blowing and the amount of soil lost as a result of blowing. Soils are grouped according to the following distinctions:

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

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible, but 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, but 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, but 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, but crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible, but crops can be grown if measures to control soil blowing are used.

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

8. Stony or gravelly soils and other soils not subject to soil blowing.

Soil and water features

Table 18 contains information helpful in planning land uses and engineering projects that are likely to be affected by soil and water features.

Hydrologic groups are used to estimate runoff from precipitation. Soils not protected by vegetation are placed in one of four groups on the basis of the intake of water after the soils have been wetted and have received 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 chiefly of deep, well drained to excessively drained sands or gravels. 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 that have a layer that impedes the downward movement of water or soils that have 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 clay soils that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding is the temporary covering of soil with water from overflowing streams and with runoff from adjacent slopes. Water standing for short periods after rains or after snow melts is not considered flooding, nor is water in swamps and marshes. Flooding is rated in general terms that describe the frequency and duration of flooding and the time of year when flooding is most likely. The ratings are based on evidence in the soil profile of the effects of flooding, namely thin strata of gravel, sand, silt, or, in places, clay deposited by floodwater; irregular decrease in organic-matter content with increasing depth; and absence of distinctive soil horizons that form in soils of the area that are not subject to flooding. The ratings are also based on local information about floodwater levels in the area and the extent of flooding and on information that relates the position of each soil on the landscape to historic floods.

The generalized description of flood hazards is of value in land-use planning and provides a valid basis for land-use restrictions. The soil data are less specific, however, than those provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table is the highest level of a saturated zone more than 6 inches thick for a continuous period of more than 2 weeks during most years. The depth to a seasonal high water table applies to undrained soils. Estimates are based mainly on the relationship between grayish colors or mottles in the soil and the depth to free water observed in many borings made during the course of the soil survey. Indicated in table 18 are the depth to the seasonal high water table; the kind of water table, that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. Only saturated zones above a depth of 5 or 6 feet are indicated.

Information about the seasonal high water table helps in assessing the need for specially designed foundations, the need for specific kinds of drainage systems, and the need for footing drains to insure dry basements. Such information is also needed to decide whether or not construction of basements is feasible and to determine how septic tank absorption fields and other underground installations will function. Also, a seasonal high water table affects ease of excavation.

Depth to bedrock is shown for all soils that are underlain by bedrock at a depth of 5 to 6 feet or less. For many soils, the limited depth to bedrock is a part of the definition of the soil series. The depths shown are based on measurements made in many soil borings and on other observations during the mapping of the soils. The kind of bedrock and its hardness as related to ease of excavation is also shown. Rippable bedrock can be excavated with a single-tooth ripping attachment on a 200-horsepower tractor, but hard bedrock generally requires blasting.

Potential frost action refers to the likelihood of damage to pavements and other structures by frost heaving and low soil strength after thawing. Frost action results from the movement of soil moisture into the freezing temperature zone in the soil, which causes ice lenses to form. Soil texture, temperature, moisture content, porosity, permeability, and content of organic matter are the most important soil properties that affect frost action. It is assumed that the soil is not covered by insulating vegetation or snow and is not artificially drained. Silty and clayey soils that have a high water table in winter are most susceptible for frost action. Well drained very gravelly or sandy soils are the least susceptible.

Risk of corrosion pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to soil moisture, particle-size distribution, total acidity, and electrical conductivity of the soil material. The rate of corrosion of concrete is based mainly on the sulfate content, texture, and acidity of the soil. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from the corrosion. Uncoated steel intersecting soil boundaries or soil horizons is more susceptible to corrosion than an installation that is entirely within one kind of soil or within one soil horizon.

Soil series and morphology

In this section, each soil series recognized in the survey area is described in detail. The descriptions are arranged in alphabetic order by series name.

Characteristics of the soil and the material in which it formed are discussed for each series. The soil is then compared to similar soils and to nearby soils of other series. Then a pedon, a small three-dimensional area of soil that is typical of the soil series in the survey area, is described. The detailed descriptions of each soil horizon follow standards in the Soil Survey Manual (*5*). Unless otherwise noted, colors described are for moist soil.

Following the pedon description is the range of important characteristics of the soil series in this survey area. Phases, or map units, of each soil series are described in the section "Soil maps for detailed planning."

Aubbeenaubbee series

The Aubbeenaubbee series consists of deep, somewhat poorly drained, moderately permeable soils on uplands. These soils formed in wind blown sandy material and the underlying glacial till. Slope ranges from 0 to 2 percent.

Aubbeenaubbee soils are similar to Blount and Crosier soils and are adjacent to Metea soils. Blount and Crosier soils do not have sandy loam textures in the upper part of the B horizon. Metea soils have slopes greater than 2 percent and do not have mottling in the B horizon.

Typical pedon of Aubbeenaubbee sandy loam, 0 to 2 percent slopes, in a cultivated area; 1,060 feet west and 2,400 feet south of the northeast corner of sec. 6, T. 29 N., R. 4 E.:

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) sandy loam; weak fine granular structure; very friable; common roots; medium acid; abrupt smooth boundary.

A2—10 to 14 inches; light brownish gray (10YR 6/2) sandy loam; few fine faint brown (10YR 5/3) mottles; weak medium platy structure parting to weak medium and fine granular; very friable; common roots; few fine iron and manganese oxide accumulations; medium acid; clear smooth boundary.

B1—14 to 22 inches; light brownish gray (10YR 6/2) sandy loam; common medium distinct dark yellowish brown (10YR 4/4) and brown (7.5YR 4/4) mottles; weak coarse subangular blocky structure; very friable; common roots; few fine iron and manganese oxide accumulations; medium acid; clear wavy boundary.

B21t—22 to 28 inches; dark yellowish brown (10YR 4/4) sandy clay loam; many medium distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few roots; light brownish gray (10YR 6/2) clay films on all peds; light gray (10YR 7/2) sandy loam in voids and channels; 2 percent gravel; many small and medium iron and manganese oxide accumulations; medium acid; clear smooth boundary.

IIB22t—28 to 37 inches; yellowish brown (10YR 5/4) clay loam; many medium distinct light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; firm; few roots; dark yellowish brown (10YR 4/4) clay films on peds; light gray (10YR 7/2) sandy loam in voids and channels; 2 percent gravel; few small iron and manganese oxide accumulations; medium acid; clear smooth boundary.

IIB3t—37 to 48 inches; dark yellowish brown (10YR 4/4) clay loam; many medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) mottles; weak coarse subangular blocky structure; firm; few roots; 5 percent gravel; few small iron and manganese oxide accumulations; neutral; abrupt wavy boundary.

IIC—48 to 60 inches; olive (5YR 5/3) loam; many medium distinct yellowish brown (10YR 5/4) mottles; massive; friable; 5 percent gravel; strong effervescence; mildly alkaline.

The solum is 40 to 60 inches thick. The upper part of the solum, which developed in sandy material, ranges from 18 to 36 inches in thickness.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2. The B1 horizon has hue of 10YR, value of 4 to 6, and chroma of 2 to 3. The B2t horizon has hue of 10YR, value of 4 or 5, and chroma of 4 to 6 and is sandy clay loam or clay loam. The IIB2t horizon has hue of 10YR, value of 4 to 6, chroma of 3 to 6, and is clay loam or loam. The IIC horizon is mildly alkaline or moderately alkaline loam or clay loam.

Blount series

The Blount series consists of deep, somewhat poorly drained, slowly and moderately slowly permeable soils on glacial till plains. These soils formed in thin deposits of loess and the underlying clay loam glacial till. Slope ranges from 0 to 3 percent.

Blount soils are similar to Crosier and Fincastle soils and are adjacent to Morley and Pewamo soils. Crosier and Fincastle soils have less clay in the B horizon and underlying glacial till. Morley soils have slopes greater than 3 percent and do not have mottling in the upper part of the B horizon. Pewamo soils have a darker colored and finer textured A horizon and are on slightly concave positions.

Typical pedon of Blount silt loam, 0 to 2 percent slopes, in a cultivated field; 1,815 feet west and 528 feet south of the northeast corner of sec. 9, T. 27 N., R. 5 E.:

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam; weak fine granular structure; friable; neutral; clear smooth boundary.

B21t—9 to 14 inches; yellowish brown (10YR 5/6) clay loam; common medium distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; thin continuous grayish brown (10YR 5/2) clay films; 2 percent gravel; common fine iron and manganese oxide accumulations; medium acid; clear smooth boundary.

B22t—14 to 24 inches; brown (10YR 5/3) clay loam; many medium distinct yellowish brown (10YR 5/6) and many faint grayish brown (10YR 5/2) mottles; moderate medium subangular and angular blocky structure; firm; thin continuous grayish brown (10YR 5/2) clay films on peds; 2 percent gravel; common fine iron and manganese oxide accumulations; slightly acid; clear smooth boundary.

B23t—24 to 34 inches; grayish brown (10YR 5/2) clay loam; many medium distinct light olive brown (2.5Y 5/4) and yellowish brown (10YR 5/6) mottles; moderate fine and medium subangular blocky structure; firm; thin continuous dark grayish brown (10YR 4/2) clay films on peds; 2 percent gravel; neutral; abrupt wavy boundary.

B3t—34 to 45 inches; grayish brown (10YR 5/2) clay loam; common medium distinct yellowish brown (10YR 5/4) mottles; weak very coarse subangular blocky structure; firm; thin patchy gray (10YR 6/1) clay films on vertical faces of peds; 2 percent gravel; mildly alkaline; abrupt wavy boundary.

C—45 to 60 inches; light olive brown (2.5Y 5/4) clay loam; many medium distinct gray (10YR 5/1) and yellowish brown (10YR 5/6) mottles; massive; firm; 2 percent gravel; strong effervescence; moderately alkaline.

The solum is 25 to 45 inches thick.

The Ap horizon is neutral or slightly acid silt loam or loam. Undisturbed areas have a very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) A1 horizon 2 to 4 inches thick. In some places an A2 horizon is present, but not generally in cultivated areas. The Bt horizon is silty clay loam, clay loam, or silty clay. It ranges from slightly acid to strongly acid in the upper part and is neutral or mildly alkaline in the lower part. The C horizon is clay loam or silty clay loam.

Brookston series

The Brookston series consists of deep, very poorly drained, moderately permeable soils on glacial till plains. They formed in calcareous, loamy glacial till. Slope ranges from 0 to 2 percent.

Brookston soils are similar to Pewamo and Rensselaer soils and are adjacent to Crosier and Miami soils. Pewamo soils have more clay in the B horizon and underlying glacial till. Rensselaer soils are underlain by stratified sediments. Crosier and Miami soils have a lighter colored surface layer and are in higher positions.

Typical pedon of Brookston loam in a cultivated field; 1,120 feet east and 130 feet north of the center of sec. 2, T. 29 N., R. 3 E.:

Ap—0 to 10 inches; very dark gray (10YR 3/1) loam; weak fine granular structure; friable; many medium and fine roots; neutral; abrupt smooth boundary.

A12—10 to 12 inches; very dark gray (10YR 3/1) loam; weak fine and medium granular structure; friable; many medium and fine roots; slightly acid; clear smooth boundary.

B21tg—12 to 24 inches; gray (10YR 5/1) clay loam; many medium distinct brownish yellow (10YR 6/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; few roots; common discontinuous distinct thin dark gray (10YR 4/1) clay films on peds and lining pores; slightly acid; clear wavy boundary.

B22tg—24 to 36 inches; gray (10YR 5/1) clay loam; many medium distinct yellowish brown (10YR 5/4) mottles; moderate medium and coarse subangular blocky structure; firm; few fine roots; common discontinuous faint thin dark gray (10YR 4/1) clay films on peds and lining pores; neutral; clear wavy boundary.

B3—36 to 49 inches; yellowish brown (10YR 5/6) clay loam; many medium distinct gray (10YR 5/1) mottles; weak coarse subangular blocky structure; firm; few discontinuous distinct thin very dark gray (10YR 3/1) clay films on peds; 2 percent gravel; neutral; abrupt wavy boundary.

C—49 to 60 inches; yellowish brown (10YR 5/4) loam; common medium distinct light olive brown (2.5Y 5/4) and gray (10YR 5/1) mottles; massive; friable; 2 percent gravel; strong effervescence; mildly alkaline.

The solum is 30 to 55 inches thick. Depth to effervescent material is the same as the thickness of the solum. Content of coarse fragments ranges from 0 to 5 percent. Reaction is slightly acid or neutral.

The A horizon ranges from 10 to 18 inches in thickness and has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is loam, silt loam, or silty clay loam. The Bt horizon has dominant hue of 10YR, value of 4 or 5, and chroma of 1 or 2 and contains common or many, distinct or prominent mottles. It is clay loam or silty clay loam.

Chelsea series

The Chelsea series consists of deep, excessively drained, rapidly permeable soils on outwash terraces, glacial till plains, and moraines. They formed in windblown deposits of fine sand. Slope ranges from 2 to 9 percent.

Chelsea soils are similar to and adjacent to Metea and Oshtemo soils. Metea soils have more clay in the lower part of the B horizon and C horizon. Oshtemo soils have more clay in the lower part of the B horizon that is continuous or occurs as thick bands.

Typical pedon of Chelsea fine sand, 2 to 9 percent slopes, in a cultivated area; 1,000 feet east and 100 feet north of the center of sec. 26, T. 29 N., R. 3 E.:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) fine sand; weak medium and coarse granular structure; very friable; many roots; neutral; abrupt smooth boundary.

A21—8 to 20 inches; yellowish brown (10YR 5/6) fine sand; single grained; loose; few roots; neutral; gradual smooth boundary.

A22—20 to 36 inches; yellowish brown (10YR 5/4) fine sand; single grained; loose; slightly acid; abrupt wavy boundary.

A&B—36 to 60 inches; yellowish brown (10YR 5/4) fine sand (A2); single grained; loose; bands of strong brown (7.5YR 5/6) loamy fine sand (Bt); weak medium and coarse subangular blocky structure; very friable; bands are 1/4 to 3/4 inch thick, spaced 1 to 7 inches apart and have a cumulative thickness of 3 inches; medium acid; abrupt wavy boundary.

The solum is 4 feet to many feet thick. Effervescent materials are not present above a depth of 60 inches or more.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The A1 horizon, where present, is 2 to 4 inches thick and has hue of 10YR, value of 3, and chroma of 1 or 2. The A2 horizon has hue of 10YR, value of 4 to 6, and chroma of 4 to 6. The B part of the A&B horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. The B part is sandy loam or loamy fine sand lamellae 1/4 to 2 inches thick. Depth to the lamellae ranges from 30 to 48 inches. Total thickness of the lamellae above a depth of 60 inches is 2 to 4 inches.

Crosier series

The Crosier series consists of deep, somewhat poorly drained, moderately slowly permeable soils on glacial till plains. These soils formed in calcareous loam glacial till. Slope ranges from 0 to 2 percent.

Crosier soils are similar to Aubbeenaubbee and Blount soils and are adjacent to Brookston and Wawasee soils. Aubbeenaubbee soils are sandy loam in the A horizon and upper part of the B horizon. Blount soils have more clay in the B horizon and underlying glacial till. Brookston soils have a darker colored surface layer and are in lower positions. Wawasee soils have slopes greater than 2 percent and do not have mottling in the B horizon.

Typical pedon of Crosier loam, 0 to 2 percent slopes, in a cultivated area; 100 feet north and 585 feet east of the center of sec. 2, T. 29 N., R. 3 E.:

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) loam; weak fine granular structure; friable; many roots; 5 percent gravel; neutral; abrupt smooth boundary.

A2—10 to 12 inches; light brownish gray (10YR 6/2) loam; weak medium subangular blocky structure; friable; common roots; 5 percent gravel; common soft iron and magnesium oxide accumulations; medium acid; clear smooth boundary.

B21t—12 to 22 inches; yellowish brown (10YR 5/4) clay loam; many medium distinct yellowish brown (10YR 5/8) and light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; firm; few roots; thin continuous light brownish gray (10YR 6/2) clay films on peds; 5 percent gravel; common soft iron and magnesium oxide accumulations; light gray (10YR 7/1) degraded silt coatings; medium acid; clear smooth boundary.

B22t—22 to 33 inches; brown (10YR 5/3) clay loam; many medium distinct yellowish brown (10YR 5/6) and light brownish gray (10YR 6/2) mottles; moderate coarse subangular blocky structure; firm; few roots; thin continuous grayish brown (10YR 5/2) clay films on peds; 5 percent gravel; few soft iron and magnesium oxide accumulations; slightly acid; abrupt wavy boundary.

C—33 to 60 inches; grayish brown (10YR 5/2) loam; many medium distinct yellowish brown (10YR 5/6) mottles; massive; friable; 5 percent gravel; strong effervescence; moderately alkaline.

The solum ranges from 20 to 40 inches in thickness. Depth to carbonates is the same as the thickness of the solum.

The Ap horizon is 7 to 12 inches thick and has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is loam or sandy loam. The A2 horizon is lacking in some pedons. It has hue of 10YR, value of 5 or 6, and chroma of 2 or 3. It is loam or sandy loam. The B horizon has hue of

10YR, value of 4 or 5, and chroma of 2 to 4, and is clay loam or loam. This horizon has common to many, fine to coarse, faint to distinct mottles.

Fincastle series

The Fincastle series consists of deep, somewhat poorly drained, moderately slowly permeable soils on uplands. These soils formed in loess and the underlying loamy glacial till. Slope ranges from 0 to 2 percent.

Fincastle soils are similar to Blount and Crosier soils and are adjacent to Treaty and Miami soils. Blount soils have more clay in the B and C horizons. Crosier soils have a loam A horizon and more sand in the B horizon. Treaty soils have a dark colored surface layer and are in lower positions. Miami soils have slopes greater than 2 percent and do not have mottling in the B horizon.

Typical pedon of Fincastle silt loam, 0 to 2 percent slopes, in a cultivated field; 2,110 feet west and 130 feet north of the southeast corner of sec. 11, T. 25 N., R. 3 E.:

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam; weak fine granular structure; friable; many roots; few fine iron and manganese oxide accumulations; slightly acid; abrupt smooth boundary.

A2—9 to 11 inches; light brownish gray (10YR 6/2) silt loam; weak medium platy structure; friable; many roots; strongly acid; clear smooth boundary.

B21t—11 to 26 inches; yellowish brown (10YR 5/4) silty clay loam; many medium distinct very dark grayish brown (10YR 3/2) and yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; firm; common roots; thin continuous light gray (10YR 7/2) clay films on peds; few iron and manganese oxide accumulations; strongly acid; clear smooth boundary.

IIB22t—26 to 32 inches; yellowish brown (10YR 5/4) clay loam; many medium distinct light brownish gray (10YR 6/2) and strong brown (7.5YR 5/6) mottles; weak coarse subangular blocky structure; firm; common roots; thin continuous dark grayish brown (10YR 4/2) clay films on peds; 2 percent gravel; many fine and medium iron and manganese oxide accumulations; medium acid; clear smooth boundary.

IIB3—32 to 46 inches; yellowish brown (10YR 5/4) loam; many medium distinct dark brown (10YR 4/3) and strong brown (7.5YR 5/8) mottles; weak coarse subangular blocky structure; friable; few roots; 5 percent gravel; slightly acid; abrupt wavy boundary.

IIC—46 to 60 inches; grayish brown (10YR 5/2) loam; massive; friable; 5 percent gravel; strong effervescence; moderately alkaline.

The solum is 36 to 70 inches thick. The upper part of the solum, which developed in silty material, ranges from 20 to 40 inches in thickness.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is neutral or slightly acid. The A2 horizon has hue of 10YR, value of 5 or 6, and chroma of 2 or 3. The Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4.

Fox series

The Fox series consists of well drained soils that are moderately deep over sand and gravel. Permeability is moderate in the subsoil and rapid in the underlying material. These soils are on outwash terraces along the valleys of major streams. The soils formed in a thin mantle of loess and the underlying stratified calcareous gravel and sand. Slope ranges from 0 to 15 percent.

Fox soils are similar to Ockley soils and are adjacent to Sebewa and Sleeth soils. Ockley soils have a thicker B horizon and are deeper to the underlying calcareous gravel and sand. Sebewa and Sleeth soils have slopes of less than 2 percent and have mottling in the B horizon. Sebewa soils have a dark colored surface layer and are in lower positions.

Typical pedon of Fox silt loam, 0 to 2 percent slopes (fig. 14), in a cultivated field; 980 feet south and 15 feet east of the northwest corner of sec. 29, T. 27 N., R. 3 E.:

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam; weak fine and medium granular structure; friable; many roots; slightly acid; abrupt smooth boundary.

B1t—9 to 14 inches; brown (7.5YR 4/4) silt loam; moderate medium and fine subangular blocky structure; friable; common roots; medium acid; clear smooth boundary.

IIB21t—14 to 24 inches; brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; common roots; thin continuous dark brown (7.5YR 3/2) clay films on peds; 10 percent gravel; medium acid; clear smooth boundary.

IIB22t—24 to 35 inches; brown (7.5YR 4/4) gravelly clay loam; moderate medium subangular blocky structure; firm; common roots; thin continuous dark brown (7.5YR 4/2) clay films on peds; 15 percent gravel; slightly acid; clear smooth boundary.

IIB3t—35 to 39 inches; very dark grayish brown (10YR 3/2) gravelly clay loam; weak medium subangular blocky structure; firm; few roots; 20 percent gravel; neutral; abrupt irregular boundary.

IIIC—39 to 60 inches; brown (10YR 5/3) stratified gravelly sand and sand; single grained; loose; strong effervescence; moderately alkaline.

The solum is 24 to 40 inches thick. The upper part of the solum, which developed in silty material, ranges from 0 to 18 inches in thickness.

The A horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is silt loam or loam. The B2t horizon has hue of 10YR and 7.5YR, value of 3 or 4, and chroma of 3 to 5. It is clay loam, gravelly clay loam, or silty clay loam. In some pedons, tongues of the B3 horizon extend into the C horizon for several feet. The C horizon varies widely in texture and thickness of the stratified gravel and sand layers.

Gessie series

The Gessie series consists of deep, well drained, moderately permeable soils on flood plains of large streams. These soils formed in loamy alluvial sediment. Slope ranges from 0 to 2 percent.

Gessie soils are similar to Shoals and Stonelick soils and are adjacent to Sloan soils. Shoals and Sloan soils are mottled above a depth of 20 inches. Sloan soils also have a dark colored surface layer. Stonelick soils are more sandy, slightly higher in elevation, and generally closer to the stream channel.

Typical pedon of Gessie silt loam in a cultivated area; 650 feet north and 70 feet east of the Mississinewa River bridge in Francis Godfroy Reserve No. 9, T. 27 N., R. 4 E.:

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam; weak fine granular structure; friable; few roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

A12—6 to 10 inches; dark grayish brown (10YR 4/2) silt loam; moderate medium subangular and angular blocky structure; firm; few roots; slight effervescence; mildly alkaline; clear smooth boundary.

C1—10 to 33 inches; brown (10YR 4/3) silt loam; weak fine granular and medium subangular blocky structure; friable; few roots; few fine shells and shell fragments; slight effervescence; mildly alkaline; clear smooth boundary.

C2—33 to 47 inches; yellowish brown (10YR 5/4) silt loam; common medium faint yellowish brown (10YR 5/6 and 5/8) mottles; weak fine granular structure; friable; strong effervescense; mildly alkaline; clear smooth boundary.

C3—47 to 60 inches; brown (10YR 5/3) silt loam; massive; friable; strong effervescence; moderately alkaline.

The solum is mildly alkaline or moderately alkaline.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is silt loam or loam. The underlying material to a depth of about 40 inches has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is silt loam, silty clay loam, or clay loam. The underlying material below a depth of 40 inches consists of stratified silt loam, loam, sandy loam, or fine sand. The strata are 1/4 to 14 inches thick and become coarser with depth.

Gilford series

The Gilford series consists of deep, very poorly drained, moderately rapidly permeable soils on outwash terraces, around the edges of large deposits of organic soils and in small stream valleys. The soils formed in sandy and loamy material. Slope ranges from 0 to 2 percent.

Gilford soils are similar to Brookston, Pewamo, and Rensselaer soils. Brookston and Pewamo soils have more clay in the B horizon and are underlain by glacial till. Rensselaer soils have more clay in the B horizon.

Typical pedon of Gilford sandy loam in a cultivated area; 2,310 feet west and 925 feet north of the southeast corner of sec. 5, T. 29 N., R. 4 E.:

Ap—0 to 10 inches; very dark gray (10YR 3/1) sandy loam; weak fine granular structure; very friable; many roots; about 1 percent gravel; slightly acid; abrupt smooth boundary.

A12—10 to 20 inches; very dark gray (10YR 3/1) sandy loam; weak fine and medium subangular blocky structure; very friable; many roots; about 1 percent gravel; neutral; gradual smooth boundary.

B21g—20 to 26 inches; gray (10YR 5/1) sandy loam; common fine faint yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; friable; few roots; very dark gray (10YR 3/1) material filling root channels; about 1 percent gravel; neutral; clear smooth boundary.

B22g—26 to 39 inches; gray (10YR 5/1) sandy loam; weak fine granular structure; very friable; few roots; neutral; about 1 percent gravel; abrupt wavy boundary.

IICg—39 to 60 inches; gray (10YR 5/1) sand with thin strata of sandy loam, silt loam, and loam; single grained; very friable; strong effervescence; mildly alkaline.

The solum is 26 to 44 inches thick. Depth to effervescent soil material is the same as the thickness of the solum. Reaction throughout the solum is slightly acid or neutral.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The Bg horizon has hue of 10YR, value of 4 to 6, and chroma of 1 or 2. The B21g horizon ranges from sandy loam to clay loam and is less than 10 inches thick. The B22g horizon ranges from loamy sand to loam. The C horizon has hue of 10YR, value of 5 or 6, and chroma of 1 or 2. It is stratified sand, loamy sand, or sandy loam.

Hennepin series

The Hennepin series consists of deep, well drained soils on narrow side slopes between flood plains and uplands and on sides of V-shaped valleys. Permeability is moderate in the solum and moderately slow in the underlying material. These soils formed in calcareous loam and clay loam glacial till. Slope ranges from 25 to 50 percent.

Hennepin soils are similar to and adjacent to Miami and Morley soils. Miami and Morley soils have a thicker B horizon and are less sloping.

Typical pedon of Hennepin silt loam, 25 to 50 percent slopes, in a wooded area; 130 feet east and 1,235 feet south of River bridge in TAH-KO-NONG Reserve No. 28, T. 26 N., R. 5 E.:

A1—0 to 3 inches; dark grayish brown (10YR 4/2) silt loam; weak fine and very fine granular structure; friable; common roots; neutral; clear smooth boundary.

B2—3 to 12 inches; brown (10YR 5/3) loam; weak very fine subangular blocky structure; friable; common roots; 2 percent gravel; slight effervescence; mildly alkaline; abrupt smooth boundary.

C1—12 to 18 inches; brown (10YR 5/3) loam; weak fine and medium subangular blocky structure; friable; few roots; 2 percent gravel; strong effervescence; moderately alkaline.

C2—18 to 60 inches; pale brown (10YR 6/3) loam; massive; friable; 5 percent gravel; strong effervescence; moderately alkaline.

The thickness of the solum is typically 12 to 18 inches but ranges from 10 to 20 inches.

The A1 horizon has hue of 10YR, value of 3 or 4, and chroma of 1 or 2. It is dominantly silt loam but ranges to loam. The B horizon ranges in thickness from 3 to 12 inches. It has hue of 10YR, value of 4 or 5, and chroma of 3 or 4 and ranges from slightly acid to moderately alkaline. It is loam or silt loam. The C horizon has hue of 10YR, value of 4 to 6, and chroma of 3 or 4 and is loam or clay loam.

Houghton series

The Houghton series consists of deep, very poorly drained, moderately rapidly permeable soils on moraines and on till, outwash, or alluvial plains. These soils formed in organic material deposited in deep depressions. Slope ranges from 0 to 2 percent.

Houghton soils are similar to Palms soils and are adjacent to Brookston, Pewamo, and Rensselaer soils. Palms soils are underlain by loamy material at a depth of 16 to 50 inches. Brookston, Pewamo, and Rensselaer soils are mineral soils and are in slightly higher positions.

Typical pedon of Houghton muck, drained, in a pasture; 200 feet east and 460 feet south of the northwest corner of sec. 4, T. 29 N., R. 4 E.:

Oa1—0 to 6 inches; black (10YR 2/1) sapric material; less than 1 percent fiber when broken, rubbed, or pressed; moderate medium and coarse granular structure; friable; few roots; slightly acid; abrupt smooth boundary.

Oa2—6 to 12 inches; black (10YR 2/1) sapric material; less than 1 percent fiber when broken, rubbed, or pressed; moderate medium and fine granular structure; friable; few roots; slightly acid; clear smooth boundary.

Oa3—12 to 26 inches; very dark grayish brown (10YR 3/2) sapric material, very dusky red (2.5YR 2/2) rubbed; 15 to 20 percent fiber, 5 percent rubbed; moderate medium platy structure; very friable; medium acid; clear smooth boundary.

Oa4—26 to 60 inches; dark brown (7.5Y 3/2) sapric material, black (10YR 2/1) rubbed; 50 percent fiber, 5 to 10 percent rubbed; weak thick platy structure; very friable; few small woody stems; slightly acid.

The organic deposits are 60 inches to many feet thick. Reaction ranges from medium acid to neutral.

The 0a1 horizon has hue of 10YR, 7.5YR, or 5Y, value of 2 or 3, and chroma of 1. The rest of the soil has hue of 10YR, 7.5YR or 5YR, value of 2 or 3, and chroma of 1 to 3. The amount of undecomposed material generally increases with depth and varies over short distances. Some pedons have a thin layer of hemic and fibric material.

Martinsville series

The Martinsville series consists of deep, well drained, moderately permeable soils on outwash terraces. These soils formed in loamy outwash sediment over glacial till. Slope ranges from 0 to 2 percent.

Martinsville soils are similar to Fox and Ockley soils. Fox soils are less deep to calcareous sand and gravelly sand strata. Ockley soils have a thin loess mantle and have more gravel in the lower part of the B horizon.

Typical pedon of Martinsville sandy loam, 0 to 2 percent slopes, in a cultivated area; 260 feet east and 1,050 feet north of the southwest corner of sec. 4, T., 29 N., R. 4 W.:

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) sandy loam; weak fine and medium granular structure; very friable; many roots; 1 percent gravel; neutral; abrupt smooth boundary.

B1—9 to 15 inches; dark brown (10YR 4/3) loam; weak fine and medium subangular blocky structure; friable; common roots; 1 percent gravel; slightly acid; clear smooth boundary.

B21t—15 to 26 inches; brown (7.5YR 4/4) clay loam; weak fine and medium subangular blocky structure; friable; few roots; thin patchy clay films on peds; 5 percent gravel; medium acid; clear smooth boundary.

B22t—26 to 37 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few roots; thin patchy clay films on peds; 5 percent gravel; medium acid; clear smooth boundary.

B3—37 to 41 inches; brown (7.5YR 4/4) sandy loam; weak fine and medium granular structure; very friable; few roots; 5 percent gravel; medium acid; abrupt smooth boundary.

C—41 to 60 inches; dark yellowish brown (10YR 4/4) stratified silty clay loam, silt loam, and loam; massive; firm; 5 percent gravel; neutral.

The thickness of the solum is typically 40 to 52 inches but ranges from 36 to 60 inches. Depth to effervescent soil material ranges from 34 to 90 inches. Reaction throughout the solum ranges from neutral to medium acid.

The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. In some pedons an A2 horizon is present and has hue of 10YR, value of 5, and chroma of 2 or 3. The B2t horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 and is clay loam or sandy clay loam. It contains from 2 to 10 percent gravel. The C horizon varies in thickness and has texture of fine sand, very gravelly sand, sand, loam, clay loam, silt loam, and silty clay loam.

Metea series

The Metea series consists of deep, well drained soils on uplands. Permeability is moderate in the subsoil and moderately slow in the underlying material. These soils formed in sandy material and the underlying glacial till. Slope ranges from 2 to 6 percent.

Metea soils are similar to Wawasee soils and are adjacent to Aubbeenaubbee, Brookston, and Crosier soils. Wawasee soils have more clay in the upper part of the B horizon. Aubbeenaubbee, Brookston, and Crosier soils have slopes of less than 2 percent and are mottled in the B horizon. Brookston soils have a dark colored surface layer and are in lower positions.

Typical pedon of Metea loamy fine sand, 2 to 6 percent slopes, in a cultivated area; 460 feet north and 890 feet east of the southwest corner of sec. 13, T. 29 N., R. 3 E.:

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) loamy fine sand; weak fine granular structure; very friable; many roots; 1 percent gravel; neutral; abrupt smooth boundary.

B21—10 to 18 inches; light yellowish brown (10YR 6/4) loamy fine sand; weak fine granular structure; very friable; common roots; 1 percent gravel; medium acid; gradual wavy boundary.

B22—18 to 28 inches; yellowish brown (10YR 5/4) loamy fine sand; weak fine granular structure; very friable; common roots; 1 percent gravel; medium acid; gradual wavy boundary.

IIB23t—28 to 37 inches; yellowish brown (10YR 5/4) clay loam; moderate medium subangular blocky structure; firm; few roots; continuous medium dark yellowish brown (10YR 4/4) clay films on peds; 5 percent gravel; medium acid; clear wavy boundary.

IIB3t—37 to 44 inches; yellowish brown (10YR 5/4) clay loam; weak medium subangular blocky structure; firm; few roots; medium discontinuous dark yellowish brown (10YR 4/4) clay films on peds; 8 percent gravel; slightly acid; abrupt wavy boundary.

IIC—44 to 60 inches; light yellowish brown (10YR 6/4) loam; massive; friable; strong effervescence; moderately alkaline.

The solum is 36 to 60 inches thick. The upper part developed in sandy material and ranges from 20 to 40 inches in thickness.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3 and is loamy fine sand or sand. In wooded areas this soil has an A1 horizon 1 to 3 inches thick. It has hue of 10YR, value of 3, and chroma of 1 or 2. Some pedons have an A2 horizon 1 to 3 inches thick. It has hue of 10YR, value of 5 or 6, and chroma of 2. The B21 and B22 horizons have hue of 10YR, value of 4 to 6, and chroma of 3 to 6. The IIBt horizon has hue of 10YR, value of 4 or 5, and chroma of 4 to 6. It is clay loam or sandy clay loam. Some soils have a sandy loam layer 1 to 3 inches thick between the B22 and IIB23t horizons. The IIC horizon is loam, clay loam, or silty clay loam till.

Miami series

The Miami series consists of deep, well drained soils on glacial till plains and moraines. Permeability is moderate in the subsoil and moderately slow in the underlying material. The soils formed in calcareous loam glacial till. Slope ranges from 2 to 18 percent.

Miami soils are similar to Metea and Morley soils and are adjacent to Treaty and Fincastle soils. Metea soils are loamy sand in the upper part of the B horizon. Morley soils have more clay in the B horizon and the underlying glacial till. Treaty soils have a darker surface layer and are in lower positions. Fincastle soils have slopes of less than 2 percent and have mottling in the B horizon.

Typical pedon of Miami silt loam, 2 to 6 percent slopes, in a cultivated area; 35 feet west and 2,390 feet north of the southeast corner of sec. 14, T. 25 N., R. 3 E.:

Ap—0 to 10 inches; dark brown (10YR 4/3) silt loam; weak very fine and fine granular structure; friable; common roots; neutral; abrupt smooth boundary.

B1—10 to 14 inches; dark yellowish brown (10YR 4/4) silt loam; moderate medium and fine subangular blocky structure; friable; common roots; slightly acid; clear wavy boundary.

IIB21t—14 to 22 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few roots; thin discontinuous dark brown (10YR 4/3) clay films on many faces of peds; 5 percent gravel; medium acid; clear smooth boundary.

IIB22t—22 to 34 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium and coarse subangular blocky structure; firm; few roots; thin continuous dark yellowish brown (10YR 4/4) clay films on peds; 5 percent gravel; slightly acid; clear smooth boundary.

IIC—34 to 60 inches; yellowish brown (10YR 5/4) loam; massive; friable; 5 percent gravel; mildly alkaline; slight effervescence.

The solum is 24 to 38 inches thick. The amount of gravel in the solum ranges from very little to about 10 percent by volume.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is loam or silt loam. In wooded areas, the A1 horizon has hue of 10YR, value of 3, and chroma of 1 or 2 and is 1 to 3 inches thick. Some pedons have an A2 horizon 1 to 3 inches thick. The B2t horizon ranges from 12 to 22 inches in thickness and is silty clay loam or clay loam. It has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 or 2. It is dominantly loam but ranges to clay loam.

Milford series

The Milford series consists of deep, very poorly drained, moderately slowly permeable soils on broad lacustrine terraces and flood plains. They formed in silty clay and silty clay loam alluvium. Slope ranges from 0 to 2 percent.

Milford soils are similar to Pewamo and Sloan soils. Pewamo soils are on uplands and are underlain by glacial till. Sloan soils have less clay throughout the profile.

Typical pedon of Milford silty clay in a cultivated area; 3,584 feet north and 1,000 feet west of the southeast corner of the Wife of Benjamin Reserve No. 24, 200 feet north and 60 feet east of the small farm bridge:

Ap—0 to 9 inches; very dark gray (10YR 3/1) silty clay; moderate fine and medium granular structure; firm; common roots; neutral; abrupt smooth boundary.

A12—9 to 15 inches; very dark gray (10YR 3/1) silty clay; common medium distinct dark yellowish brown (10YR 3/4) mottles; moderate medium prismatic structure; firm; common roots; neutral; clear smooth boundary.

B21g—15 to 25 inches; dark gray (N 4/0) silty clay; moderate medium prismatic structure; firm; many reddish brown (5YR 4/3) accumulations of iron oxide in voids and channels; clear smooth boundary.

B22g—25 to 45 inches; gray (2.5Y 5/1) silty clay; weak coarse prismatic structure; firm; many strong brown (7.5YR 5/6) accumulations of iron oxide in voids and channels; neutral; clear smooth boundary.

C—45 to 60 inches; gray (10YR 5/1) silty clay loam; weak coarse prismatic structure; firm; many strong brown (7.5YR 5/6) accumulations of iron oxide in voids and channels; mildly alkaline.

The solum is 36 to 48 inches thick.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is silty clay loam or silty clay and slightly acid or neutral. The B horizon has hue of 2.5Y and 10YR, value of 4 to 6, and chroma of 1 or 2. In some pedons, this horizon is neutral and has value of 4 to 6. The B horizon is neutral or mildly alkaline silty clay loam or silty clay. The C horizon is silty clay loam or silty clay.

Millsdale series

The Millsdale series consists of moderately deep, very poorly drained, moderately slowly permeable soils on terraces. They formed in glacial drift over limestone bedrock. Slope ranges from 0 to 2 percent.

Millsdale soils are adjacent to Fox and Milton soils. Fox and Milton soils have a lighter colored surface layer and are in higher positions. Fox soils are underlain by stratified gravel and sand.

Typical pedon of Millsdale silty clay loam (fig. 15) in a cultivated area; 1,380 feet west and 20 feet south of the northeast corner of sec. 29, T. 27 N., R. 4 E.:

Ap—0 to 6 inches; black (10YR 2/1) silty clay loam; moderate medium subangular blocky structure; firm; many roots; mildly alkaline; clear smooth boundary.

A12—6 to 12 inches; black (10YR 2/1) silty clay loam; weak medium subangular blocky structure; firm; common roots; thin continuous dark gray (10YR 4/1) clay films on faces of peds; mildly alkaline; gradual smooth boundary.

B21tg—12 to 21 inches; gray (10YR 5/1) silty clay; many medium distinct light yellowish brown (2.5Y 6/4) mottles; moderate medium angular and subangular blocky structure; firm; medium continuous dark gray

(10YR 4/1) clay films on peds; common roots; 2 percent gravel; few fragments of partially weathered limestone; mildly alkaline; gradual wavy boundary.

IIB22tg—21 to 31 inches; light gray (10YR 7/1) silty clay; many medium distinct pale yellow (2.5Y 7/4) mottles; moderate medium subangular blocky structure; firm; few roots; medium continuous gray (N 6/0) clay films on peds; 2 percent gravel; many fragments of partially weathered limestone; mildly alkaline; gradual wavy boundary.

IICr—31 to 36 inches; soft limestone bedrock; abrupt smooth boundary.

IIR—36 inches; hard limestone bedrock.

The solum is 20 to 34 inches thick. Depth to limestone bedrock is the same as the thickness of the solum. Reaction throughout the solum is neutral or mildly alkaline.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The B21tg horizon has hue of 10YR, value of 3 to 5, and chroma of 1 or 2 and is silty clay, silty clay loam, or clay loam. The B22tg horizon has hue of 2.5Y or 10YR, value of 4 to 7, and chroma of 1 or 2 and is silty clay loam, silty clay, or clay loam. The amount of partially weathered limestone fragments ranges from 10 to 60 percent and increases in amount and size with depth.

Milton series

The Milton series consists of moderately deep, well drained, moderately permeable soils on outwash terraces along the valleys of major streams. These soils formed in thin deposits of glacial outwash and limestone bedrock. Slope ranges from 0 to 2 percent.

Milton soils are similar to Fox soils and are adjacent to Millsdale and Gessie soils. Fox soils have less clay in the B horizon and are underlain by strata of gravelly sand and sand. Millsdale soils have a dark colored surface layer and are in lower positions. Gessie soils are in lower positions, have less clay in the B horizon, and are subject to flooding.

Typical pedon of Milton silt loam, 0 to 2 percent slopes, in a pasture; 585 feet east and 1,625 feet north of the southwest corner of F. Lafountain Reserve, T. 27 N., R. 3 E.:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; weak fine granular structure; friable; many roots; 5 percent gravel; neutral; abrupt smooth boundary.

B1—8 to 12 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; common roots; 10 percent gravel; neutral; clear smooth boundary.

B21t—12 to 21 inches; dark yellowish brown (10YR 4/4) gravelly clay loam; moderate medium subangular blocky structure; firm; few roots; medium continuous dark brown (10YR 3/3) clay films on peds; 15 percent gravel and cobbles; slightly acid; clear smooth boundary.

B22t—21 to 32 inches; dark yellowish brown (10YR 4/4) gravelly clay loam; moderate medium subangular blocky structure; firm; few roots; medium continuous very dark grayish brown (10YR 3/2) clay films on peds; many fragments of partially weathered limestone; gradual smooth boundary.

IICr—32 to 37 inches; soft limestone bedrock; abrupt smooth boundary.

IIR—37 inches; hard limestone bedrock.

The solum is 20 to 40 inches thick. Depth to limestone bedrock is the same as the thickness of the solum. In places depth to bedrock is uniform, but in others the depth is variable within short distances.

The A horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The B21t horizon has hue of 10YR and 7.5YR, value of 4, and chroma of 3 or 4 and is silty clay loam or clay loam. The B22t horizon is dark yellowish brown (10YR 4/4) or dark brown (10YR 4/3, 3/3) gravelly clay, silty clay, or clay loam. The amount of partially weathered limestone fragments ranges from 5 to 30 percent and increases with depth.

Morley series

The Morley series consists of deep, moderately well drained, moderately slowly or slowly permeable soils on glacial till plains and moraines. The soils formed in loamy glacial till. Slope ranges from 2 to 25 percent.

Morley soils are similar to Miami soils and are adjacent to Blount and Pewamo soils. Miami soils have less clay in the B horizon and underlying glacial till. Blount soils have slopes of less than 3 percent and have mottling in the B horizon. Pewamo soils have a dark colored surface layer and are in lower positions.

Typical pedon of Morley silt loam, 2 to 6 percent slopes, in a cultivated area; 660 feet west and 330 feet north of the center of sec. 15, T. 29 N., R. 5 E.:

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam; weak fine and medium granular structure; friable; common roots; 5 percent gravel; slightly acid; abrupt smooth boundary.

B21t—7 to 13 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate medium subangular blocky structure; firm; common roots; thin discontinuous dark yellowish brown (10YR 4/4) clay films on peds; 5 percent gravel; medium acid; clear smooth boundary.

IIB22t—13 to 24 inches; dark yellowish brown (10YR 4/4) clay loam; weak medium prismatic structure parting to moderate medium angular and subangular blocky; firm; few roots; thin continuous dark brown

(10YR 3/3) clay films on peds; 5 percent gravel; slightly acid; abrupt wavy boundary.

IIB3—24 to 35 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium and coarse subangular blocky structure; firm; few roots; thin continuous dark grayish brown (10YR 4/2) clay films on peds; 5 percent gravel; slight effervescence; mildly alkaline; abrupt wavy boundary.

IIC--35 to 60 inches; grayish brown (10YR 5/2) clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; massive; firm; 5 percent gravel; slight effervescence; mildly alkaline.

The solum is 20 to 45 inches thick.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. In wooded areas this soil has an A1 horizon 1 to 3 inches thick. It has hue of 10YR, value of 3, and chroma of 1 or 2. A few pedons have an A2 horizon 1 to 3 inches thick. It has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The B2t horizon has hue of 10YR, chroma of 3 or 4, and value of 4 or 5 and is clay loam, silty clay loam, or silty clay. The B22t horizon is strongly acid to medium acid. The C horizon is mildly alkaline or moderately alkaline silty clay loam or clay loam.

Ockley series

The Ockley series consists of deep, well drained, moderately permeable soils on outwash terraces. These soils formed in a loess mantle and loamy glacial drift over stratified gravel and sand. Slope ranges from 0 to 6 percent.

Ockley soils are similar to Fox soils and are adjacent to Rensselaer and Sleeth soils. Fox soils have a thinner B horizon and are less deep to the underlying calcareous gravel and sand. Rensselaer and Sleeth soils have slopes of less than 2 percent and have mottling in the B horizon. Rensselaer soils have a dark colored surface layer and are in lower positions.

Typical pedon of Ockley silt loam, 0 to 2 percent slopes, in a cultivated area; 10 feet east and 300 feet south of the northwest corner of L. Godfroy Reserve, T. 27 N., R. 3 E.:

Ap—0 to 9 inches; dark brown (10YR 4/3) silt loam; weak fine and medium granular structure; friable; many roots; neutral; abrupt smooth boundary.

A2—9 to 12 inches; dark yellowish brown (10YR 4/4) silt loam; weak medium platy structure parting to moderate fine subangular blocky; friable; many roots; neutral; clear smooth boundary.

B21t—12 to 18 inches; brown (7.5YR 4/4) silty clay loam; moderate medium subangular blocky structure; firm; thin continuous dark yellowish brown (10YR 4/4) clay films on peds; common roots; medium acid; gradual smooth boundary.

IIB22t—18 to 40 inches; brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; thin continuous dark brown (7.5YR 3/2) clay films on peds; few roots; 2 percent gravel; medium acid; clear wavy boundary.

IIB23t—40 to 48 inches; dark brown (7.5YR 3/2) gravelly clay loam; moderate medium and coarse subangular blocky structure; firm; thin dark brown (7.5YR 4/4) clay films on peds; 25 percent gravel; neutral; abrupt irregular boundary.

IIIC—48 to 60 inches; brown (10YR 5/3) stratified gravelly sand and sand; loose; single grained; strong effervescence; moderately alkaline.

The solum is 40 to 60 inches thick. Depth to loose stratified gravelly sand and sand is the same as the thickness of the solum. The silt mantle ranges from 6 to 20 inches in thickness. The amount of gravel ranges from 0 to 10 percent in the upper part of the solum and from 18 to 40 percent in the lower part.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. The A1 horizon, where present, is 2 to 4 inches thick. It is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) silt loam. The upper part of the Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4 and is clay loam, silty clay loam, sandy clay loam, or gravelly clay loam.

Ormas series

The Ormas series consists of deep, well drained, moderately rapidly permeable soils on outwash terraces along the valleys of major streams. They formed in sandy outwash that has been reworked by wind and in the underlying calcareous gravelly sand and sand. Slope ranges from 2 to 8 percent.

Ormas soils are similar to Oshtemo soils and are adjacent to Chelsea and Fox soils. Oshtemo soils do not have a sandy A horizon more than 20 inches thick. Chelsea soils are sandier and have less clay in the B horizon. Fox soils are less deep to calcareous gravelly sand and sand and have more clay in the B horizon.

Typical pedon of Ormas loamy sand, in an area of Ormas-Oshtemo loamy sands, 2 to 8 percent slopes, in a cultivated field; 530 feet west and 1,400 feet north of the center of sec. 3, T. 28 N., R. 5 E.:

Ap—0 to 12 inches; brown (10YR 4/3) loamy sand; pale brown (10YR 6/3) dry; single grained; very friable; neutral; abrupt smooth boundary.

A12—12 to 24 inches; brown (10YR 5/3) loamy sand; single grained; very friable; medium acid; clear wavy boundary.

A13—24 to 38 inches; brown (10YR 5/3) sand; single grained; very friable; slightly acid; abrupt wavy boundary.

B21t—38 to 44 inches; brown (7.5YR 4/4) sandy loam; moderate medium subangular blocky structure; friable; medium acid; clear smooth boundary.

B22t—44 to 52 inches; brown (7.5YR 4/4) gravelly sandy clay loam; moderate medium subangular blocky structure; firm; few thin (7.5YR 4/3) clay films; medium acid; clear smooth boundary.

B3t—52 to 59 inches; brown (10YR 4/3) gravelly sandy loam; weak coarse subangular blocky structure; friable; weak effervescence; mildly alkaline; abrupt irregular boundary.

IIC—59 to 64 inches; yellowish brown (10YR 5/8) gravelly sand containing thin strata of sand; single grained; loose; strong effervescence; mildly alkaline.

The solum is 50 to 60 inches thick. The upper part, which developed in sandy material, ranges from 20 to 40 inches in thickness. Content of coarse fragments in the lower part of the solum and the IIC horizon ranges from 15 to 30 percent.

The Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 3. In wooded areas this soil has an A1 horizon 1 to 3 inches thick. It has hue of 10YR, value of 3, and chroma of 1 or 2. The Bt horizon has hue of 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is sandy loam, sandy clay loam, gravelly sandy loam, or gravelly sandy clay loam. The IIC horizon is gravelly or very gravelly sand and contains strata of sand or coarse sand.

Oshtemo series

The Oshtemo series consists of deep, well drained soils on outwash terraces along the valleys of major streams. Permeability is moderately rapid in the solum and very rapid in the underlying material. These soils formed in a mantle of sandy loam and the underlying calcareous gravelly sand and sand. Slope ranges from 0 to 8 percent.

Oshtemo soils are similar to Fox and Ormas soils and are adjacent to Rensselaer and Sleeth soils. Fox soils are less deep to calcareous gravelly sand and sand and have more clay in the B horizon. Ormas soils have more than 2 feet of loamy sand on the surface. Rensselaer and Sleeth soils have slopes of less than 2 percent and have mottling in the B horizon. Rensselaer soils have dark colored surface layers and are in lower positions.

Typical pedon of Oshtemo sandy loam, 0 to 4 percent slopes, in a cultivated field; 400 feet east and 2,820 feet south of the northwest corner of sec. 21, T. 28 N., R. 5 E.:

Ap—0 to 11 inches; dark brown (10YR 4/3) sandy loam; weak fine and medium granular structure; very friable; common roots; slightly acid; abrupt smooth boundary.

B21t—11 to 24 inches; dark yellowish brown (10YR 4/4) sandy loam; weak medium granular and subangular blocky structure; very friable; few roots; few thin discontinuous clay films on peds; medium acid; clear smooth boundary.

B22t—24 to 40 inches; dark brown (7.5YR 4/4) sandy loam; weak medium and coarse subangular blocky structure; friable; few thin discontinuous clay films on peds; 10 percent fine gravel; medium acid; clear smooth boundary.

B3—40 to 51 inches; dark brown (7.5YR 4/4) loamy fine sand; weak medium subangular blocky structure; very friable; strongly acid; abrupt wavy boundary.

IIC—51 to 60 inches; dark yellowish brown (10YR 4/4) gravelly sand; single grained; loose; strong effervescence; moderately alkaline.

The solum is 40 to 60 inches thick.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. In uncultivated areas the A1 horizon is 1 to 4 inches thick and has hue of 10YR, value of 3, and chroma of 2 or 3. The B2t horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 or 4. It is sandy loam, gravelly sandy loam, or sandy clay loam. Some pedons have a thin dark brown gravelly clay loam, gravelly sandy loam, or sandy loam layer above the IIC horizon.

Palms series

The Palms series consists of deep, very poorly drained soils in deep depressions on till, outwash, or alluvial plains and moraines. They are moderately rapidly permeable in the organic material and moderately permeable in the underlying mineral material. These soils formed in organic material deposited over medium textured mineral material. Slope ranges from 0 to 2 percent.

Palms soils are similar to Houghton soils and are adjacent to Brookston, Pewamo, and Rensselaer soils. Houghton soils have deep organic deposits. Brookston, Pewamo, and Rensselaer soils are mineral soils and are in slightly higher positions.

Typical pedon of Palms muck, drained, in a pasture; 300 feet east and 460 feet south of the northwest corner of sec. 4, T. 29 N., R. 4 E.:

Oa1—0 to 6 inches; black (N 2/0) sapric material, broken and rubbed; 1 percent fiber when broken, rubbed, or pressed; moderate medium granular structure; friable; many roots; slightly acid; abrupt smooth boundary.

Oa2—6 to 12 inches; black (N 2/0) sapric material, broken and rubbed; less than 1 percent fiber when broken, rubbed, and pressed; moderate medium subangular blocky structure; firm; common roots; slightly acid; clear smooth boundary.

Oa3—12 to 17 inches; black (10YR 2/1) sapric material; broken and rubbed; 10 percent fiber when broken; 1 percent fiber when rubbed and pressed; weak medium subangular blocky structure; friable; few roots; medium acid; clear smooth boundary.

Oa4—17 to 25 inches; very dark grayish brown (10YR 3/2) sapric material broken, black (10YR 2/1) rubbed; 40 percent fiber broken, 5 to 10 percent fiber rubbed and pressed; weak coarse platy structure; very friable; few woody stems; slightly acid; clear smooth boundary.

IICg—25 to 60 inches; very dark gray (10YR 3/1) silt loam; common medium distinct dark grayish brown (2.5Y 4/2) and common medium faint dark gray (10YR 4/1) mottles; massive; friable; mildly alkaline.

The depth of the organic material ranges from 16 to 40 inches. The amount of decomposed material generally increases with depth and varies within short distances. There is a thin layer of hemic material in some pedons. The IIC horizon is generally loam or silt loam but can be sandy loam, clay loam, and silty clay loam.

Patton series

The Patton series consists of deep, poorly drained, moderately permeable soils formed in silty lake plain sediment on broad upland till plains. Slope ranges from 0 to 2 percent.

Patton soils are similar to Treaty and Pewamo soils and are adjacent to Blount and Morley soils. Treaty and Pewamo soils are underlain by calcareous glacial till. Pewamo soils have more clay in the B horizon. Blount and Morley soils have a lighter colored surface layer and are in higher positions.

Typical pedon of Patton silty clay loam in a cultivated field; 726 feet west and 1,780 feet north of the center of sec. 25, T. 26 N., R. 4 E.:

Ap—0 to 10 inches; very dark gray (10YR 3/1) silty clay loam; weak fine granular structure; firm; common roots; slightly acid; abrupt smooth boundary.

B1g—10 to 13 inches; very dark gray (10YR 3/1) silty clay loam; common medium distinct brown (7.5YR 4/4) streaks and mottles; moderate medium angular and subangular blocky structure; firm; common roots; neutral; gradual smooth boundary.

B2g—13 to 26 inches; dark gray (5Y 4/1) silty clay loam; many medium distinct olive (5Y 5/4) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few roots; dark gray (10YR 4/1) material filling root channels; neutral; gradual smooth boundary.

B3g—26 to 38 inches; gray (5Y 6/1) silty clay loam; moderate medium distinct yellowish brown (10YR 5/6, 5/8) mottles; moderate medium subangular blocky structure; firm; few roots; dark gray (10YR 4/1) material filling root channels; neutral; abrupt wavy boundary.

Cg—38 to 70 inches; gray (10YR 6/1) silt loam; common medium distinct brownish yellow (10YR 6/8) mottles; massive; friable; very thin strata of silt; strong effervescence; mildly alkaline.

The solum is 30 to 42 inches thick. Depth to effervescent material is the same as the thickness of the solum.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is silt loam or silty clay loam. The Bg horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2. The mottles have hue of 10YR, value of 4 to 6, and chroma of 3 to 8.

Pewamo series

The Pewamo series consists of deep, very poorly drained, moderately slowly permeable soils on glacial till plains and moraines. These soils formed in silty and loamy glacial till. Slope ranges from 0 to 2 percent.

Pewamo soils are similar to Brookston and Rensselaer soils and are adjacent to Blount and Morley soils. Brookston soils have less clay in the B and C horizon. Rensselaer soils have less clay in the B horizon and are underlain by stratified sediments. Blount and Morley soils have a lighter colored surface layer and are in higher positions.

Typical pedon of Pewamo silty clay loam in a cultivated field; 1,660 feet north and 250 feet east of the center of sec. 19, T. 25 N., R. 6 E.:

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay loam; weak fine and medium granular structure; firm; common roots; neutral; abrupt smooth boundary.

A12—8 to 13 inches; black (10YR 2/1) silty clay loam; moderate; fine angular blocky structure; firm; common roots; neutral; clear smooth boundary.

B21tg—13 to 21 inches; dark gray (10YR 4/1) silty clay; common medium distinct light olive brown (2.5Y 5/4) mottles; moderate fine and medium angular blocky structure; very firm; few roots; medium continuous dark gray (10YR 4/1) clay films on peds; very dark gray (10YR 3/1) material filling channels; 2 percent gravel; neutral; gradual smooth boundary.

B22tg—21 to 29 inches; olive gray (5Y 5/2) silty clay; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium angular blocky; very firm; medium continuous gray (5Y 5/1) clay films on peds; very dark gray (10YR 3/1) material filling channels; few roots; 2 percent gravel; neutral; gradual smooth boundary.

B23tg—29 to 37 inches; gray (10YR 6/1) silty clay loam; many medium distinct brownish yellow (10YR 6/6) and yellowish brown (10YR 5/8) mottles; weak medium and coarse subangular blocky structure; firm; thin to thick discontinuous gray (5Y 5/1) clay films on peds; few roots; very dark gray (10YR 3/1) material filling channels; 2 percent gravel; mildly alkaline; gradual smooth boundary.

B3tg—37 to 43 inches; gray (10YR 6/1) clay loam; many medium distinct yellowish brown (10YR 5/4, 5/6) mottles; weak very coarse subangular blocky structure; firm; thin patchy gray (5Y 5/1) clay films on peds; few roots; 2 percent gravel; very dark gray (10YR 3/1) material filling channels; mildly alkaline; abrupt wavy boundary.

Cg—43 to 60 inches; light brownish gray (10YR 6/2) clay loam; many medium distinct yellowish brown (10YR 5/6, 5/8) mottles; massive; firm; 2 percent gravel; strong effervescence; moderately alkaline.

The solum is 30 to 50 inches thick. Depth to effervescent material is the same as the thickness of the solum. Content of coarse fragments ranges from 0 to 5 percent.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The B2tg horizon ranges from 10 to 30 inches in thickness and has hue of 10YR, value of 4 to 6, and chroma of 1 or 2. It is silty clay loam, silty clay, or clay loam. The C horizon is clay loam or silty clay loam.

Rensselaer series

The Rensselaer series consists of deep, very poorly drained, moderately permeable soils on terraces and in small sluiceways on moraines. They formed in loamy outwash sediments. Slope ranges from 0 to 2 percent.

Rensselaer soils are similar to Brookston and Pewamo soils and are adjacent to Oshtemo and Sleeth soils. Brookston and Pewamo soils are underlain by calcareous glacial till. Oshtemo and Sleeth soils have a lighter colored surface layer and are in higher positions.

A typical pedon of Rensselaer loam in a cultivated field; 1,450 feet east and 110 feet north of the center of sec. 3, T. 28 N., R. 5 E.:

Ap—0 to 9 inches; very dark gray (10YR 3/1) loam; weak fine and medium granular structure; friable; common roots; neutral; abrupt smooth boundary.

A12—9 to 14 inches; very dark gray (10YR 3/1) loam; weak fine granular structure; friable; common roots; slightly acid; clear smooth boundary.

B21tg—14 to 24 inches; olive gray (5Y 4/2) clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; dark gray (10YR 4/1) thin clay films on peds; few roots; common red (10YR 4/8) iron stains; slightly acid; gradual smooth boundary.

B22tg—24 to 32 inches; dark gray (10YR 4/1) clay loam; common medium distinct yellowish brown (10YR 5/6) and gray (10YR 6/1) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; gray (10YR 6/1) thin clay films on peds; few roots; slightly acid; gradual smooth boundary.

B3tg—32 to 41 inches; dark gray (10YR 4/1) clay loam; few fine distinct pale olive (5Y 6/3) mottles; weak medium subangular blocky structure; firm; 5 percent gravel; slightly acid; abrupt wavy boundary.

IICg—41 to 60 inches; dark gray (10YR 4/1) loamy sand; massive; very friable; strong effervescence; moderately alkaline.

The solum is 33 to 55 inches thick.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is dominantly loam but can be silt loam and silty clay loam. The Bt horizon has hue of 10YR, 2.5Y, and 5Y, value of 4 or 5, and chroma of 1 or 2 and contains common to many, distinct to prominent mottles. It is clay loam or silty clay loam. The IIC horizon is loamy sand, sandy loam, or sand. Some pedons are stratified and thickness is variable over short distances.

Ross series

The Ross series consists of deep, well drained, moderately permeable soils adjacent to flood plains of large streams. These soils formed in loamy alluvial sediments. Slope ranges from 0 to 2 percent.

These soils have a mollic epipedon less than 20 inches thick and they lack a cambic horizon of the Ross series. These differences do not alter the usefulness or behavior of the soil.

Ross soils are similar to Gessie and Shoals soils and are adjacent to Hennepin soils. Gessie and Shoals soils have a lighter colored surface layer and are in lower positions. Shoals soils are mottled at a depth of less than 20 inches. Hennepin soils are steep and very steep.

Typical pedon of Ross loam in a cultivated area; 1,200 feet west and 800 feet south of the northeast corner of sec. 23, T. 27 N., R. 4 E.:

Ap—0 to 8 inches; very dark gray (10YR 3/1) loam; moderate fine and medium granular structure; friable; few roots; neutral; abrupt smooth boundary.

A12—8 to 12 inches; very dark gray (10YR 3/1) loam; weak fine subangular blocky structure; friable; few roots; neutral; clear smooth boundary.

C1—12 to 27 inches; brown (10YR 4/3) loam; weak medium and fine subangular blocky structure; friable; few roots; neutral; clear smooth boundary.

C2—27 to 37 inches; dark yellowish brown (10YR 4/4) loam; weak coarse granular structure; friable; few roots; neutral; clear smooth boundary.

C3—37 to 46 inches; brown (10YR 4/3) sandy loam; weak coarse granular structure; friable; neutral; clear smooth boundary.

C4—46 to 60 inches; dark yellowish brown (10YR 4/4) loam; many medium distinct dark grayish brown mottles; massive; friable; few small iron and manganese oxide accumulations; neutral.

The A horizon has hue of 10YR, value of 3, and chroma of 1 to 3 and is loam or silt loam. The underlying material to a depth of about 40 inches has hue of 10YR, value of 3 to 5, and chroma of 2 to 4 and is loam, silt loam, clay loam, or sandy loam. The underlying material below a depth of 40 inches has hue of 10YR, value of 4 or 5, and chroma of 3 to 5 and is silty clay loam, clay loam, silt loam, loam, sandy loam, or gravelly sand. The thickness, color, and texture of the C horizon vary over short distances and usually become coarser with depth.

Sebewa series

The Sebewa series consists of very poorly drained soils that are moderately deep over sand and gravel. Permeability is moderate in the solum and rapid in the underlying material. These soils are on outwash terraces and in some small stream valleys. The soils formed in loamy material over gravel and sand. Slope ranges from 0 to 2 percent.

Sebewa soils are similar to Rensselaer soils and are adjacent to Oshtemo and Sleeth soils. Rensselaer soils have less gravel in the lower part of the B horizon and the C horizon. Oshtemo and Sleeth soils have a lighter colored surface layer and are in higher positions.

Typical pedon of Sebewa loam in a cultivated field; 1,200 feet south and 50 feet west of the northeast corner of sec. 19, T. 28 N., R. 5 E.:

Ap—0 to 8 inches; very dark gray (10YR 3/1) loam; weak medium granular structure; friable; common roots; 2 percent gravel; neutral; abrupt smooth boundary.

A12—8 to 12 inches; very dark gray (10YR 3/1) loam; moderate medium subangular and angular blocky structure; firm; few roots; 2 percent gravel; neutral; clear smooth boundary.

B21tg—12 to 19 inches; dark gray (10YR 4/1) clay loam; many medium distinct light olive brown (2.5Y 5/4) and brown (10YR 4/3) mottles; moderate medium subangular blocky structure; firm; few roots; thin patchy dark gray (10YR 4/1) clay films on most peds; 2 percent gravel; neutral; gradual smooth boundary.

B22tg—19 to 24 inches; grayish brown (10YR 5/2) clay loam; many medium distinct brownish yellow (10YR 6/6), olive brown (2.5Y 4/4), and light olive brown (2.5Y 5/4) mottles; moderate medium subangular blocky structure; firm; few roots; thin patchy dark gray (10YR 4/1) clay films on most peds; 10 percent gravel; neutral; gradual smooth boundary.

B3tg—24 to 33 inches; grayish brown (10YR 5/2) gravelly clay loam; many medium distinct brownish yellow (10YR 6/8), dark gray (10YR 4/1), and light olive brown (2.5Y 5/4) mottles; weak medium subangular blocky structure; firm; few roots; thin patchy dark grayish brown (10YR 4/2) clay films on peds; 20 percent gravel; mildly alkaline; abrupt wavy boundary.

IIC—33 to 60 inches; grayish brown (10YR 5/2) stratified gravelly sand and sand; single grained; loose; strong effervescence; moderately alkaline.

The solum is 24 to 40 inches thick.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2 and is loam, silt loam, or clay loam. The Bt horizon ranges from 15 to 25 inches in thickness. It has hue of 5Y, 2.5YR, and 10YR, value of 4 or 5, and chroma of 1 or 2 and is clay loam, gravelly clay loam, or sandy clay loam. The IIC horizon is stratified gravelly sand and sand, coarse sand, or gravel. The amount of gravel is variable.

Shoals series

The Shoals series consists of deep, somewhat poorly drained, moderately permeable soils on flood plains. These soils formed in loamy alluvial flood plain sediment. Slope ranges from 0 to 2 percent.

Shoals soils are similar to Gessie and Stonelick soils and are adjacent to Sloan soils. Gessie and Stonelick soils are well drained, lack mottling, and are slightly higher in elevation and generally closer to the stream channel. Sloan soils have a darker surface layer and are slightly lower in elevation.

Typical pedon of Shoals silt loam in a cultivated field; 1,980 feet west and 726 feet north of the crossroads between Francis Godfroy Reserve No. 9 and Reserve No. 24, T. 27 N., R. 5 E.:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; weak fine and medium granular structure; common roots; friable; neutral; abrupt smooth boundary.

C1—8 to 15 inches; yellowish brown (10YR 5/4) silt loam; many medium distinct dark grayish brown (10YR 5/2) mottles; moderate fine and medium granular structure; friable; common roots; few iron and manganese accumulations; neutral; gradual smooth boundary.

C2—15 to 22 inches; dark grayish brown (10YR 4/2) silt loam; many medium distinct dark yellowish brown (10YR 4/4) and brownish yellow (10YR 6/6) mottles; massive; friable; few roots; dark grayish brown (10YR 4/2) material filling root channels; many medium black (10YR 2/1) iron and manganese accumulations; neutral; gradual smooth boundary.

C3—22 to 60 inches; dark yellowish brown (10YR 4/4) loam; many medium distinct grayish brown (10YR 5/2) and dark brown (7.5YR 4/4) mottles; massive; friable; neutral; clear smooth boundary.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 1 to 3 and is silt loam or loam. The C horizon above a depth of 40 inches has hue of 10YR, value of 4 or 5, and chroma of 2 to 4, and is distinctly mottled. Most subhorizons between a depth of 10 to 30 inches have dominant chroma of 2 or higher. The C horizon above a depth of 40 inches is dominantly silt loam or loam. Below a depth of 40 inches it is generally stratified silt loam, loam, sandy loam, and silty clay loam.

Sleeth series

The Sleeth series consists of deep, somewhat poorly drained, moderately permeable soils on broad, gently undulating outwash terraces. These soils formed in loamy material over calcareous stratified gravelly sand. Slope ranges from 0 to 2 percent.

Sleeth soils are similar to Blount and Crosier soils and are adjacent to Ockley and Oshtemo soils. Blount and Crosier soils are underlain by glacial till. Ockley soils do not have mottles in the B horizon. Oshtemo soils have less clay and do not have mottling in the B horizon.

Typical pedon of Sleeth loam in a cultivated field; 1,900 feet east and 95 feet south of the northwest corner of sec. 25, T. 28 N., R. 4 E.:

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) loam; weak fine and medium granular structure; friable; common roots; neutral; abrupt smooth boundary.

A2—10 to 14 inches; grayish brown (10YR 5/2) loam; common medium faint yellowish brown (10YR 5/4) mottles; weak thin and medium platy structure parting to weak fine and medium granular; friable; common roots; dark grayish brown (10YR 4/2) material filling channels; slightly acid; clear smooth boundary.

B1t—14 to 20 inches; yellowish brown (10YR 5/6) sandy clay loam; moderate medium distinct grayish brown (10YR 5/2) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; few roots; grayish brown (10YR 5/2) thin clay films on most peds; slightly acid; clear smooth boundary.

B2tg—20 to 33 inches; grayish brown (10YR 5/2) gravelly clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; few roots; 25 percent gravel; continuous medium grayish brown (10YR 5/2) clay films on all peds; slightly acid; gradual smooth boundary.

B3tg—33 to 45 inches; grayish brown (10YR 5/2) gravelly clay loam; common medium distinct yellowish brown (10YR 5/4) mottles; moderate medium and coarse subangular blocky structure; firm; 20 percent gravel; discontinuous medium brown (10YR 5/3) clay films on many faces of peds; neutral; abrupt wavy boundary.

IIC—45 to 60 inches; yellowish brown (10YR 5/4) very gravelly sand and sand; single grained; loose; strong effervescence; moderately alkaline.

The solum is 40 to 60 inches thick. The upper part of the solum, which developed in silty material, ranges from 0 to 20 inches in thickness.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2 and is loam or silt loam. The A2 horizon is often mixed in plowing with the Ap horizon. The B2t horizon is silty clay loam, sandy clay loam, or clay loam. The amount of gravel increases with depth and ranges from 5 to 30 percent. Strata in the IIC horizon are variable over short horizontal and vertical distances.

Sloan series

The Sloan series consists of deep, very poorly drained, moderately permeable soils on flood plains. These soils formed in alluvial sediment. Slope ranges from 0 to 2 percent.

Sloan soils are similar to Milford soils and are adjacent to Gessie and Shoals soils. Milford soils have more clay throughout the profile. Gessie and Shoals soils have a lighter colored surface layer, are slightly higher in elevation, and are better drained.

Typical pedon of Sloan silty clay loam in a cultivated area; 150 feet north and 20 feet east of the center of sec. 19, T. 27 N., R. 4 E.:

Ap—0 to 5 inches; very dark gray (10YR 3/1) silty clay loam; moderate medium granular structure; firm; neutral; abrupt smooth boundary.

A12—5 to 18 inches; very dark gray (10YR 3/1) silty clay loam; weak and moderate fine and medium angular blocky structure; firm; neutral; gradual smooth boundary.

B21g—18 to 28 inches; dark gray (10YR 4/1) loam; common medium distinct yellowish brown (10YR 5/4) mottles; moderate medium prismatic structure parting to moderate coarse subangular blocky; friable; neutral; gradual smooth boundary.

B22g—28 to 35 inches; dark grayish brown (10YR 4/2) silt loam; common medium distinct olive brown (2.5Y 4/4) mottles; moderate medium prismatic structure parting to weak coarse subangular blocky; friable; neutral; gradual smooth boundary.

B3g—35 to 42 inches; dark grayish brown (10YR 4/2) clay loam; common medium distinct light olive brown (2.5Y 5/4) mottles; massive; firm; neutral; gradual wavy boundary.

Cg—42 to 60 inches; olive gray (5Y 5/2) loam; common medium distinct yellowish brown (10YR 5/6) mottles;

massive; friable; strong effervescence; mildly alkaline.

The solum ranges from slightly acid to mildly alkaline in the upper part and from neutral to moderately alkaline in the lower part. The depth to calcareous material ranges from about 20 to 40 inches.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of l or 2. It is silty clay loam, loam, or silt loam. The B horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2 and is silty clay loam, clay loam, silt loam, or loam. The C horizon is stratified and varies in texture.

Stonelick series

The Stonelick series consists of deep, well drained, moderately rapidly permeable soils on flood plains of large streams. These soils formed on natural levees of streams and other elongated, slightly elevated areas near the stream channel. Slope ranges from 0 to 2 percent.

Stonelick soils are similar to Gessie soils and are adjacent to Shoals and Sloan soils. Gessie soils are less sandy and are at slightly lower elevations. Shoals and Sloan soils are mottled and more poorly drained. Sloan soils also have a dark colored surface layer.

A typical pedon of Stonelick sandy loam in a cultivated area; 90 feet south and 340 feet west of the northeast corner of sec. 35, T. 27 N., R. 4 E.:

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) sandy loam; weak fine granular structure; very friable; many roots; few shells; slight effervescence; moderately alkaline; abrupt smooth boundary.

C1—10 to 26 inches; dark brown (10YR 4/3) sandy loam; weak coarse subangular blocky structure parting to weak fine and medium granular; very friable; few roots; few shells; slight effervescence; moderately alkaline; clear smooth boundary.

C2—26 to 40 inches; dark brown (10YR 4/3) loam; weak coarse subangular blocky structure parting to weak fine and medium granular; friable; no roots; few shells; slight effervescence; moderately alkaline; clear smooth boundary.

C3—40 to 60 inches; dark yellowish brown (10YR 4/4) silt loam; massive; friable; few shells; slight effervescence; moderately alkaline.

The solum ranges from neutral to moderately alkaline.

The A horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. In uncultivated areas, there is an A1 horizon 1 to 3 inches thick that has hue of 10YR, value of 3, and chroma of 1 or 2 and is sandy loam or loam. The C horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 3 or 4. It is stratified silt loam, loam, sandy loam, and loamy sand; the layers become coarser with depth.

Treaty series

The Treaty series consists of deep, poorly drained, moderately permeable soils on glacial till plains. These soils formed in silty loess underlain by loam glacial till. Slope ranges from 0 to 2 percent.

Treaty soils are similar to Brookston and Pewamo soils and are adjacent to Fincastle soils. Brookston soils have more sand in the solum. Pewamo soils have more clay in the solum and C horizon. Fincastle soils have a lighter colored surface layer, are in slightly higher positions, and have more sand in the lower part of the B horizon.

Typical pedon of Treaty silt loam in a cultivated field; 265 feet north and 230 feet west of the southeast corner of sec. 1, T. 25 N., R. 3 E.:

Ap—0 to 10 inches; very dark gray (10YR 3/1) silt loam; weak fine and medium granular structure; friable; few roots; neutral; abrupt smooth boundary.

A12—10 to 12 inches; very dark gray (10YR 3/1) silt loam; weak medium granular and subangular blocky structure; friable; few roots; neutral; gradual smooth boundary.

B21tg—12 to 24 inches; gray (10YR 5/1) silty clay loam; many medium distinct yellowish brown (10YR 5/6) and olive brown (2.5Y 4/4) mottles; moderate medium subangular blocky structure; firm; few roots; discontinuous thin dark grayish brown (10YR 4/2) clay films on peds and lining pores; neutral; gradual smooth boundary.

B22t—24 to 38 inches; gray (10YR 5/1) silty clay loam; many medium distinct yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; firm; few roots; thin distinct dark gray (10YR 4/1) clay films lining pores and on peds; neutral; gradual smooth boundary.

IIB3—38 to 45 inches; light olive brown (2.5Y 5/4) loam; many medium distinct gray (10YR 6/1) and strong brown (7.5YR 5/6) mottles; weak coarse subangular blocky structure; friable; thin discontinuous dark gray (10YR 4/1) clay films in pores and on some peds; 2 percent gravel; neutral; abrupt wavy boundary.

IIC—45 to 60 inches; olive brown (2.5Y 4/4) loam; common medium distinct gray (10YR 6/1) and yellowish brown (10YR 5/4) mottles; massive; friable; 2 percent gravel; strong effervescence; mildly alkaline.

The solum is 30 to 50 inches thick and is slightly acid or neutral.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2 and is silt loam or silty clay loam. The Bt horizon has dominant hue of 10YR, value of 4 or 5, and chroma of 1 and is distinctly mottled. The IIB horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4 and is distinctly mottled. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 or 4 and is silt loam or loam.

Washtenaw series

The Washtenaw series consists of deep, very poorly drained, slowly permeable soils on uplands. The soils are in small drainageways and at the base of slopes around deep depressions. They formed in alluvium and the underlying loamy glacial till. Slope ranges from 0 to 2 percent.

Washtenaw soils are similar to Pewamo and Brookston soils and are adjacent to Houghton and Morley soils. Pewamo and Brookston soils do not have overwash. Houghton soils are organic. Morley soils are in sloping areas at higher elevations and are often the source of overwash.

Typical pedon of Washtenaw silt loam in a cultivated field; 1,590 feet west and 70 feet north of the southeast corner of sec. 8, T. 29 N., R. 5 E.:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; weak fine granular structure; friable; common roots; slightly acid; abrupt smooth boundary.

C1—8 to 23 inches; dark grayish brown (10YR 4/2) silt loam; weak fine granular structure; friable; few roots; slightly acid; gradual smooth boundary.

IIA1b—23 to 32 inches; very dark gray (10YR 3/1) clay loam; weak medium subangular blocky structure parting to moderate medium and fine granular; firm; few roots; neutral; gradual smooth boundary.

IIB21tgb—32 to 44 inches; dark gray (10YR 4/1) clay loam; common medium distinct brown (10YR 4/3) mottles; moderate medium subangular blocky structure; firm; thin clay films on peds; few roots; very dark gray (10YR 3/1) material filling worm and root channels; neutral; clear smooth boundary.

IIB22tgb—44 to 60 inches; dark grayish brown (10YR 4/2) clay loam; common medium faint dark brown (10YR 4/3) mottles; moderate medium subangular blocky structure; firm; thin clay films on some peds; very dark gray (10YR 3/1) organic coatings on surfaces of peds and filling worm and root channels; neutral; gradual smooth boundary.

IIB3g—60 to 70 inches; yellowish brown (10YR 5/4) clay loam; many medium distinct gray (10YR 6/1) and light brownish gray (10YR 6/2) mottles; weak coarse subangular blocky structure; firm; dark grayish brown (10YR 4/2) organic coatings on peds and filling worm and root channels; neutral; abrupt smooth boundary.

IIC—70 to 75 inches; brown (10YR 5/3) loam; many coarse faint grayish brown (10YR 5/2) mottles; massive; friable; slight effervescence; moderately alkaline.

The overwash ranges from 20 to 25 inches in thickness. It has hue of 10YR, value of 4 or 5, and chroma of 2 or 3 and is silt loam or loam. The buried A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2 and is clay loam, silty clay loam, loam, or silt loam. The IIB2t horizon has hue of 10YR, value of 4 to 6, and chroma of 1 or 2. It is clay loam or silty clay loam. The IIB3g horizon, where present, ranges from 4 to 12 inches in thickness. The underlying buried IIC horizon is clay loam, loam, or gravelly sand and sand.

Wawasee series

The Wawasee series consists of deep, well drained, moderately permeable soils on glacial till plains and moraines. They formed in loamy glacial till. Slope ranges from 2 to 18 percent.

Wawasee soils are similar to Metea and Morley soils and are adjacent to Brookston and Crosier soils. Metea soils are sandy in the upper part of the B horizon. Morley soils have more clay in the B horizon and underlying glacial till. Brookston soils have a darker colored surface layer and are in lower positions. Crosier soils have slopes of less than 2 percent and have mottling in the B horizon.

Typical pedon of Wawasee sandy loam, 2 to 6 percent slopes, in a cultivated area; 130 feet south and 2,440 feet west of the northwest corner of sec. 13, T. 29 N., R. 3 E.:

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) sandy loam; weak fine granular structure; very friable; many roots; 2 percent gravel; neutral; abrupt smooth boundary.

A2—7 to 9 inches; pale brown (10YR 6/3) sandy loam; weak medium platy structure parting to weak fine granular; very friable; common roots; 2 percent gravel; neutral; abrupt smooth boundary.

B1—9 to 15 inches; yellowish brown (10YR 5/4) sandy loam; moderate medium and fine subangular blocky structure; friable; common roots; 2 percent gravel; medium acid; clear wavy boundary.

B21t—15 to 24 inches; yellowish brown (10YR 5/4) loam; moderate medium subangular blocky structure; firm; common roots; 2 percent gravel; medium acid; clear smooth boundary.

B22t—24 to 32 inches; yellowish brown (10YR 5/4) loam; moderate medium blocky structure; firm; few roots; thin continuous dark yellowish brown (10YR 4/4) clay films on peds and lining some pores; 5 percent gravel; slightly acid; clear smooth boundary.

B3t—32 to 36 inches; yellowish brown (10YR 5/4) loam; weak coarse subangular blocky structure; friable; few roots; thin discontinuous dark yellowish brown (10YR 4/4) clay films on peds; 5 percent gravel; neutral; abrupt wavy boundary.

C—36 to 60 inches; light yellowish brown (10YR 6/4) loam; massive; friable; 5 percent gravel; slight effervescence; moderately alkaline.

The solum ranges from 28 to 40 inches in thickness. The amount of coarse fragments in the solum ranges from very few to about 10 percent by volume.

The A horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is sandy loam or loam. In wooded areas this soil has an A1 horizon 1 to 3 inches thick that is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). Some pedons have an A2 horizon 1 to 3 inches thick. The B2t horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4 and is loam, sandy clay loam, or sandy loam. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 to 6. It is loam or sandy loam.

Classification of the soils

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Readers interested in further details about the system should refer to "Soil taxonomy" (*6*).

The system of classification has six categories. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. In this system the classification is based on the different soil properties that can be observed in the field or those that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or of factors that affect soil genesis. In table 19, the soils of the survey area are classified according to the system. Categories of the system are discussed in the following paragraphs.

ORDER. Ten soil orders are recognized as classes in the system. The properties used to differentiate among orders are those that reflect the kind and degree of dominant soil-forming processes that have taken place. Each order is identified by a word ending in *sol*. An example is Alfisol.

SUBORDER. Each order is divided into suborders based primarily on properties that influence soil genesis and are important to plant growth or that are selected to 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 expression of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and a prefix that suggests something about the properties of the soil. An example is Hapludalfs (*Hapl*, meaning simple horizons, plus *udalfs*, the suborder of Alfisols that have an udic moisture regime).

SUBGROUP. Each great group may be divided into three subgroups: the central (typic) concept of the great groups, which is not necessarily the most extensive subgroup; the intergrades, or transitional forms to other orders, suborders, or great groups; and the extragrades, which have some properties that are representative of the great groups 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 is thought to typify the great group. An example is Typic Hapludalfs.

FAMILY. Families are established within a subgroup on the basis of similar physical and chemical properties that affect management. Among the properties considered in horizons of major biological activity below plow depth are particle-size distribution, mineral content, temperature regime, thickness of the soil penetrable by roots, consistence, moisture equivalent, soil slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for the soil properties used as family differentiae. An example is fine-loamy, mixed, mesic, Typic Hapludalfs.

SERIES. The series consists of soils that formed in a particular kind of material and have horizons that, except for texture of the surface soil or of the underlying substratum, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineral and chemical composition.

Formation of the soils

In this section the major factors of soil formation and their importance in the formation of the soils in Miami County are discussed.

Factors of soil formation

Soil is produced by soil-forming processes acting on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material accumulated and has existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are the active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that forms. In extreme cases parent material almost entirely determines the profile. Finally, time is needed for changing the parent material into a soil profile. Some time is always required for differentiation of soil horizons. Usually, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effects of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent material

Parent material is the unconsolidated mass in which a soil forms. Parent material determines the limits of the chemical and mineralogical composition of the soil.

The parent materials of most of the soils in Miami County were deposited by glaciers or by melt water from the glaciers. Some of these materials were subsequently reworked and redeposited by water and wind. The glaciers covered the county from about 10,000 years to 12,000 years ago. Although the parent materials are of common glacial origin, their properties vary greatly, sometimes within small areas, depending on how the materials were deposited.

The dominant parent materials in Miami County were glacial till, outwash deposits, lacustrine deposits, alluvium, and organic material.

Glacial till was laid down directly by glaciers with a minimum of water action. It consists of particles of different sizes mixed together. The small pebbles in glacial till have sharp corners, indicating that they have not been worn by water washing. The glacial till in Miami County is calcareous and firm loam or clay loam. An example of soils formed in glacial till are those of the Blount series. These soils typically are medium textured and have well developed structure.

Outwash material was deposited by running water from melting glaciers. The size of the particles that make up outwash material varies according to speed of the stream of water that carried them. When the water slows down, the coarser particles are deposited. Finer particles, such as very fine sand, silt, and clay, can be carried by slower moving water. Outwash deposits generally consist of layers of particles of similar size, such as sandy loam, sand, gravel, or other coarse particles. Oshtemo soils, for example, formed in deposits of outwash material.

Lacustrine material was deposited from still, or ponded, glacial melt water. Because the coarser fragments drop out of moving water as outwash, only the finer particles, such as very fine sand, silt, and clay, remain to settle out in still water. Lacustrine material is silty or clayey in texture. In Miami County, soils that formed in lacustrine material are typically moderately fine textured. Patton soils, for example, formed in lacustrine material.

Alluvium is deposited by floodwaters of present streams in recent time. This material varies in texture, depending on the speed of the water from which it was deposited. The alluvium deposited along a swift stream like the Eel River is coarser textured than that deposited along a slow, sluggish stream like Pipe Creek. Examples are Stonelick and Shoals soils.

Organic material consists of deposits of plant remains. After the glaciers withdrew from the areas, water was left standing in depressions in outwash, lake, and till plains. Grasses and sedges growing around the edges of these lakes died, and their remains fell to the bottom. Because of wetness of the areas, the plant remains did not decompose. Later, white-cedar and other water-tolerant trees grew in the areas. As these trees died, their residue became a part of the organic accumulations. The lakes were eventually filled with organic material and developed into areas of muck and peat. In some of these areas, the plant remains subsequently decomposed. In other areas, the material has changed little since deposition. Houghton soils, for example, formed in organic material.

Plant and animal life

Plants have been the principal organisms influencing the soils in Miami County; however, the activities of bacteria, fungi, earthworms, and man have also been important. The chief contribution of plants and animals is the addition of organic matter and nitrogen to the soil. The kind of organic material on and in the soil depends on the kind of plants that grow on the soil. The remains of these plants accumulate in the surface and decay. Roots of the plants provide channels for downward movement of water through the soil and add organic matter as they decay. Bacteria in the soil help to break down the organic matter so that it can be used by growing plants.

The native vegetation in Miami County was mainly deciduous forest. Differences in natural soil drainage and minor differences in parent material affected the composition of the forest.

The well drained upland soils, such as Miami, Morley, and Metea soils were covered mainly with sugar maple, beech, walnut, and hickory. Chelsea soils were covered with black oak and scrub oak. The wet soils carried primarily maple, oak, and willow. A few wet soils also have sphagnum and other mosses, which contributed substantially to the accumulation of organic matter.

Brookston and Pewamo soils formed under wet conditions and contain considerable amounts of organic matter. The soils that formed dominantly under forest generally have less organic matter than soils that formed dominantly under grass.

Climate

Climate is important in the formation of soils. It determines the kind of plant and animal life on and in the soil. It determines the amount of water available for weathering minerals and transporting soil material. Climate, through its influence on temperature in the soil, determines the rate of chemical reaction in the soil. These influences are important, but are rather uniform over as large an area as a county.

The climate in Miami County is cool and humid. This is presumably similar to that which existed as the soils formed. The soils in Miami County differ from soils that formed in a dry, warm climate and from those that formed in a hot, moist climate. Climate is fairly uniform throughout the county. There are minor differences in the soils in Miami County as the result of small differences in climate. More detailed information on the climate of this county is given in the section "General nature of the county."

Relief

Relief, or topography, has a marked influence on soils through its influence on natural drainage, erosion, plant cover, and soil temperature. In Miami County, slope ranges from nearly level to very steep. Natural soil drainage ranges from well drained on the ridgetops to very poorly drained in the depressions.

Relief influences the formation of soils by affecting runoff and drainage; drainage in turn, by affecting aeration of the soil, affects the color of the soil. Runoff of water is greatest on the steeper slopes, but in low areas water is temporarily ponded. Water and air move freely through soils that are well drained but slowly through soils that are very poorly drained. In soils that are well aerated, the iron and aluminum compounds that give most soils their color are brightly colored and oxidized, and in poorly aerated soils the color is dull gray and mottled. Ockley soils are well drained and well aerated, and Rensselaer soils are poorly aerated and very poorly drained.

Intermediate between the very poorly drained and well drained soil are the poorly drained, somewhat poorly drained, and moderately well drained soils.

Time

Time, usually a long time, is required for distinct horizons to form in parent material. The differences in length of time that the parent materials have been in place are commonly reflected in the degree of development of the soil profile. Some soils develop rapidly, others slowly.

The soils in Miami County range from young to mature. The glacial deposits in which many of the soils formed have been exposed to soil-forming factors for a long enough time to allow distinct horizons to develop within the soil profile. Some soils forming in recent alluvial sediments, however, have not been in place long enough for distinct horizons to develop.

Shoals soils formed in alluvial material. Blount and Fincastle soils are older, and the effect of time on leaching of lime can be noted. The upper part of Blount and Fincastle soils originally had about the same amount of lime as the C horizon of these soils has today. Sebewa soils were submerged under glacial lake water and protected from leaching. In contrast, Oshtemo soils were above water and subject to leaching. The difference in length of time of leaching is reflected in the soils. The Sebewa soils are leached of lime to a depth of 33 inches, but Oshtemo soils are limy or calcareous only below a depth of 51 inches.

Processes of soil formation

Several processes have been involved in the formation of the soils in this county. These processes are the accumulation of organic matter; the solution, transfer, and removal of calcium carbonates and bases; and the liberation and translocation of silicate clay minerals. In most soils, more than one of these processes have been active in horizon differentiation.

Some organic matter has accumulated in the surface layer of all soils in this county. The organic matter content of some soils is moderate, but that of others is high. Generally, the soils that have the most organic matter, such as soils of the Brookston and Rensselaer series, have a thick, black surface layer.

Carbonates and bases have been leached from the upper part of nearly all of the soils of this county. Almost all of the carbonates and some of the bases have been leached from the A and B horizons of well drained soils. Even in the wettest soils, some leaching is indicated by the absence of carbonates and by acid reaction. Leaching is slow in wet soils because water stops percolating at a high water table or because permeability is slow.

Clay accumulates in pores and other voids and forms films on the structural ped surfaces along which water moves. In Miami soils, for example, translocated silicate clays have accumulated in the B2t horizon in the form of clay films.

Leaching of bases and translocation of silicate clays are among the more important processes in horizon differentiation in the soils of this county. Leaching of carbonates is generally believed to precede translocation of silicate clay minerals.

The reduction and transfer of iron, called gleying, has occurred in all of the very poorly drained and somewhat poorly drained soils in Miami County. In the naturally wet soils, this process has been significant in horizon differentiation. The gray color of the subsoil indicates redistribution of iron oxides. The reduction is commonly accompanied by some transfer of the iron, either from upper horizons to lower horizons or completely out of the profile. Mottles, which are in some horizons, indicate segregation of iron.

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Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; 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. An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

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	More than 9

Base saturation. The degree to which material having base exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the 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 frequent flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

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 loosen the subsoil and bring clods to the surface. A form of emergency tillage to control soil blowing.

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 coat, clay skin.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the bases of steep slopes.

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.

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.

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 40 or 80 inches (1 or 2 meters).

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. Unstable walls of cuts made by earthmoving equipment. The soil sloughs easily.

Depth to rock. Bedrock at a depth that adversely affects the specified use.

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 for 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, as for example in "hillpeats" and "climatic moors."

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 running 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 a bare surface.

Excess fines. Excess silt and clay. The soil does not provide 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.

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.*

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.

Fine textured (heavy textured) soil. Sandy clay, silty clay, and clay.

Flooding. The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. 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 an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; *November-May*, for example, means that flooding can occur during the period November through May. Water standing for short periods after rainfall or commonly covering swamps and marshes is not considered flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Frost action. Freezing and thawing of soil moisture. Frost action can damage 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 assorted and unassorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by melt water as it flows from glacial ice.

Glacial till (geology). Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material from 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Green manure (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, which is the upper limit of saturation.

Habitat. The natural abode of a plant or animal; refers to the kind of environment in which a plant or animal normally lives, as opposed to the range or geographical distribution.

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. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.—The mineral horizon, formed or forming at or near the surface, in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon most of which was originally part of a B horizon.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered, but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration 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.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

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. Inadequate strength for supporting loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Moderately coarse textured (moderately light textured) soil. Sandy loam and fine sandy loam.

Moderately fine textured (moderately heavy 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. 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 mixed with mineral soil material. The content of organic matter is more than 20 percent.

Munsell notation. A designation of color by degrees of the three single 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.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by water that originated mainly from the melting of glacial ice. Glacial outwash is commonly in valleys on landforms known as valley trains, outwash terraces, eskers, kame terraces, kames, outwash fans, or deltas.

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.

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. The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the soil. Terms describing permeability are *very slow* (less than 0.06 inch), *slow* (0.06 to 0.20 inch), *moderately slow* (0.2 to 0.6 inch), *moderate* (0.6 to 2.0 inches), *moderately rapid* (2.0 to 6.0 inches), *rapid* (6.0 to 20 inches), and *very rapid* (more than 20 inches).

pH value. (See Reaction, soil). A numerical designation of acidity and alkalinity in soil.

Piping. Moving water forms subsurface tunnels or pipelike cavities in the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from a semisolid to a plastic state.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Poor outlets. Surface or subsurface drainage outlets difficult or expensive to install.

Productivity (soil). The capability of a soil for producing a specified plant or sequence of plants under a specified system of management. Productivity is measured in terms of output, or harvest, in relation to input.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is 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.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. 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. The rapid movement of water through the soil. Seepage adversely affects the specified use.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow intake. The slow movement of water into the soil.

Slow refill. The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones. Rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Small stones adversely affect the specified use.

Soil. A natural, three-dimensional body at the earth's surface that 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: *very coarse sand* (2.0 millimeters to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsides. When drained, organic soil material collapses and the surface sinks.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

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 or management.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. A stream terrace is frequently called a second bottom, in contrast with a flood plain, and is seldom subject to overflow. A marine terrace, generally wide, was deposited by 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, silt loam, 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. 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 condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil (engineering). Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

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.

ILLUSTRATIONS

Figure 1.—Frequent changes in slope are characteristic of the Packerton moraine.

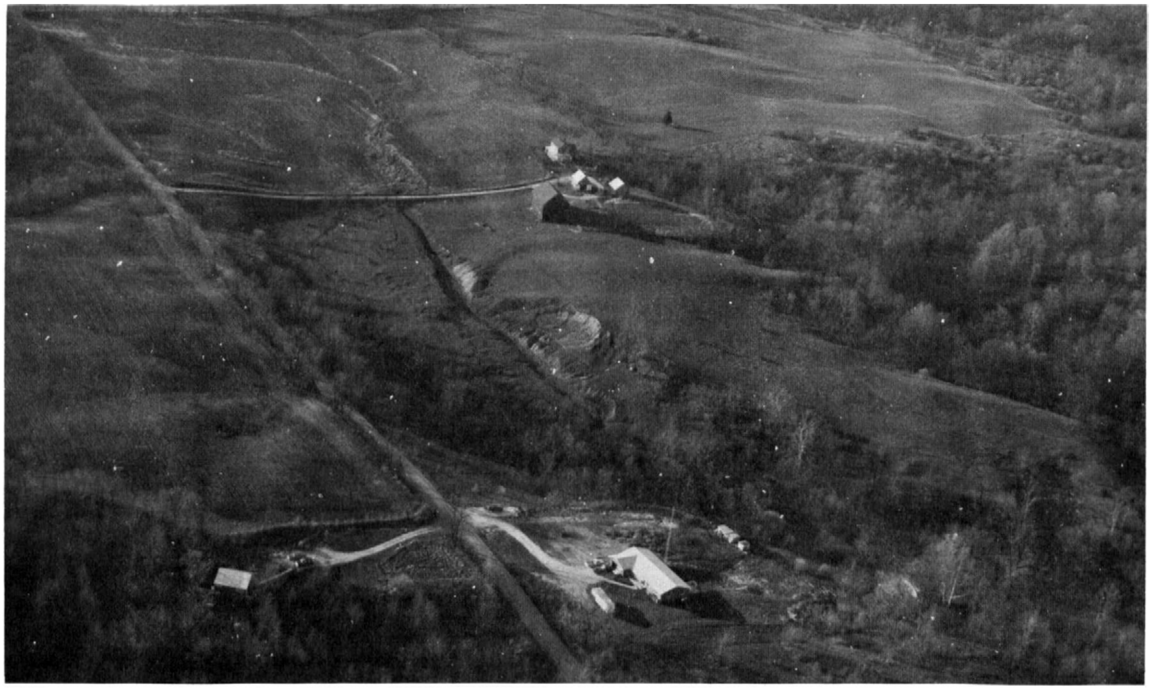

Figure 2.—Typical area of Morley, Blount, and Pewamo soils on the Packerton moraine in northern Miami County.

Figure 3.—Area of the Fox-Oshtemo map unit. Dark areas are Fox silt loam, and light areas are Oshtemo soils. The vegetated ridge in center is Chelsea soils.

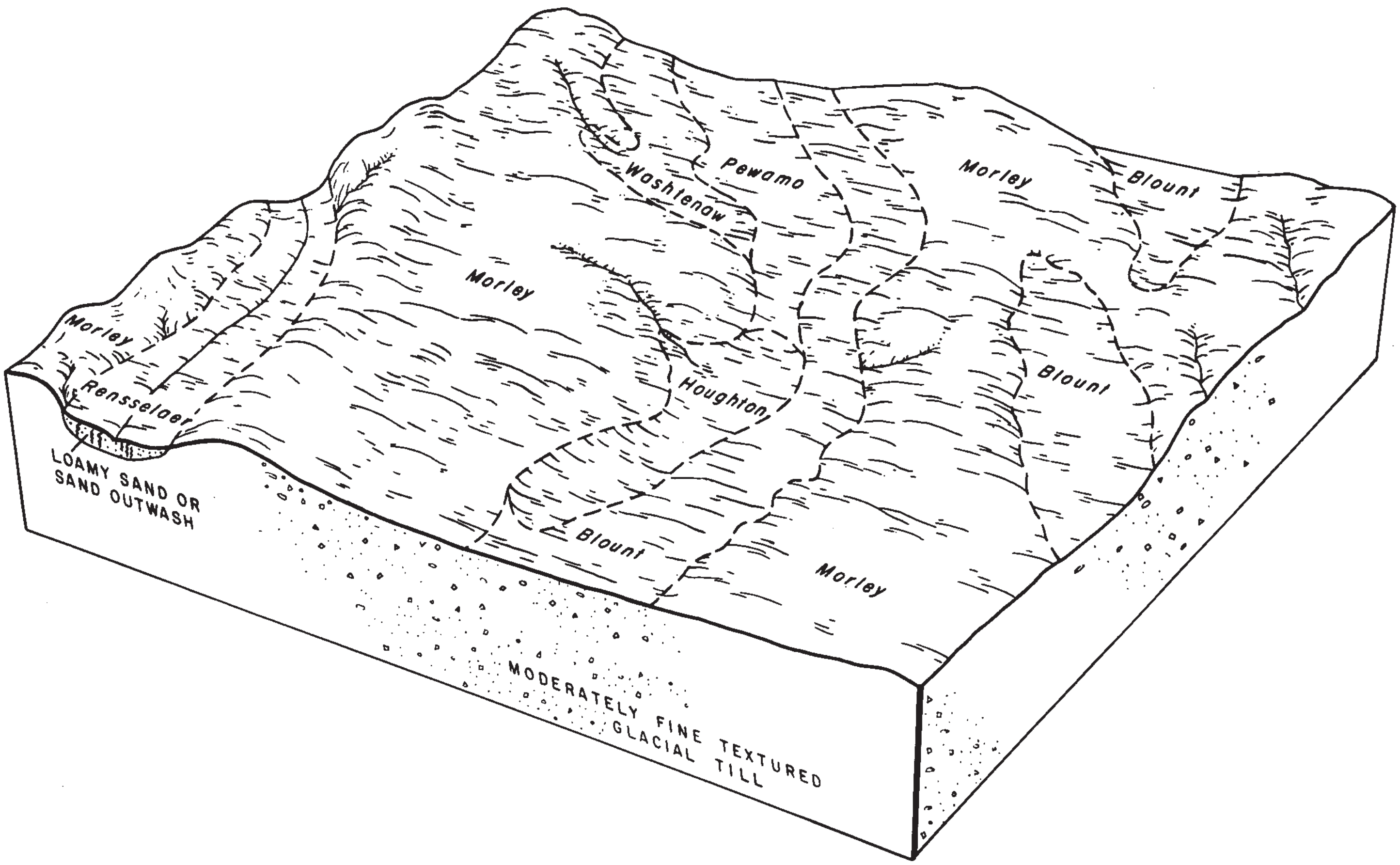

Figure 4.—Pattern of soils, topography, and underlying material in Morley-Blount-Pewamo map unit.

Figure 5.—Area of the Wawasee-Crosier-Brookston map unit. Light areas are Wawasee and Metea soils, gray areas are Crosier soils, and dark areas are Brookston and Gilford soils.

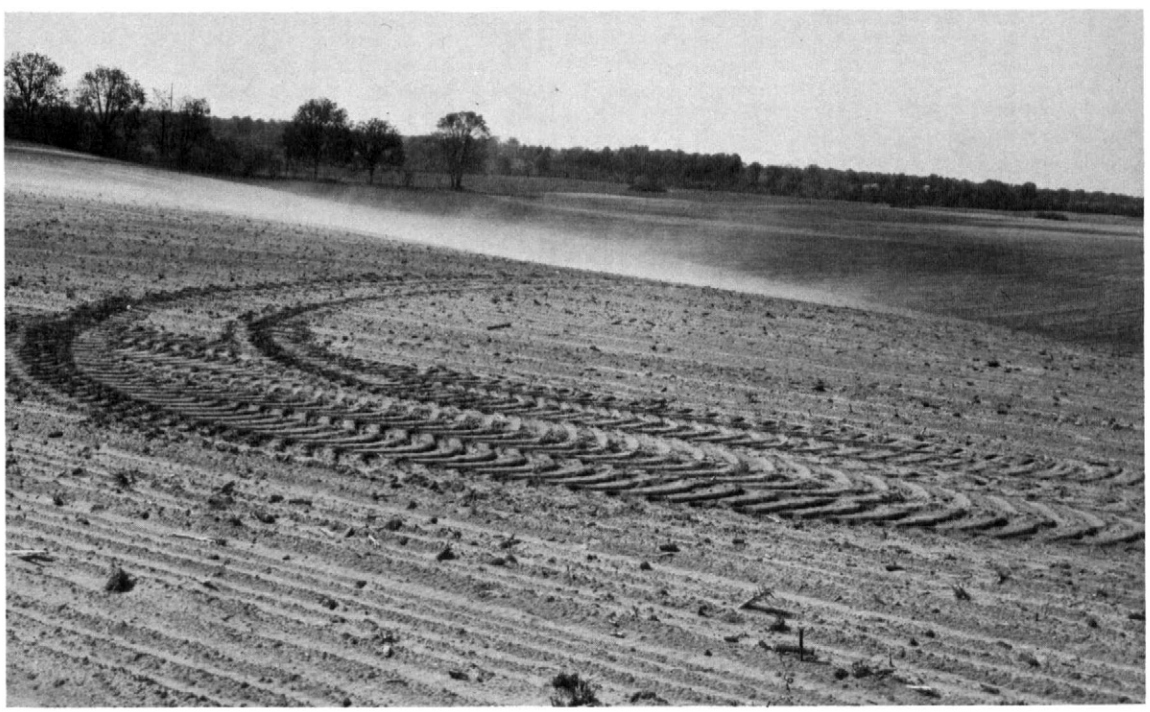

Figure 6.—Soil blowing on Chelsea fine sand, 2 to 9 percent slopes.

Figure 7.—Native hardwoods on Hennepin silt loam, 25 to 50 percent slopes.

Figure 8.—Erosion control is needed on Wawasee sandy loam, 2 to 6 percent slopes.

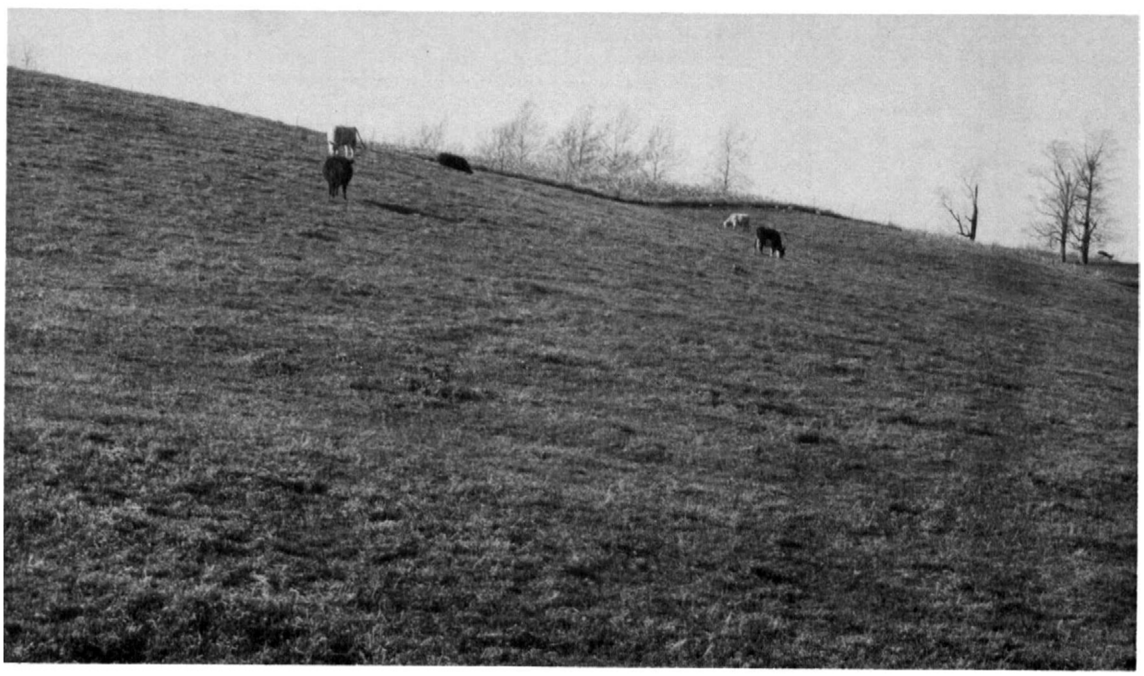

Figure 9.—Grass and legume pasture is the main use of Wawasee loam, 12 to 18 percent slopes, severely eroded.

Figure 10.—Wetness is a major limitation on crop production in Miami County. Many areas of Houghton, Brookston, and Rensselaer soils need artificial drainage to be used for crops.

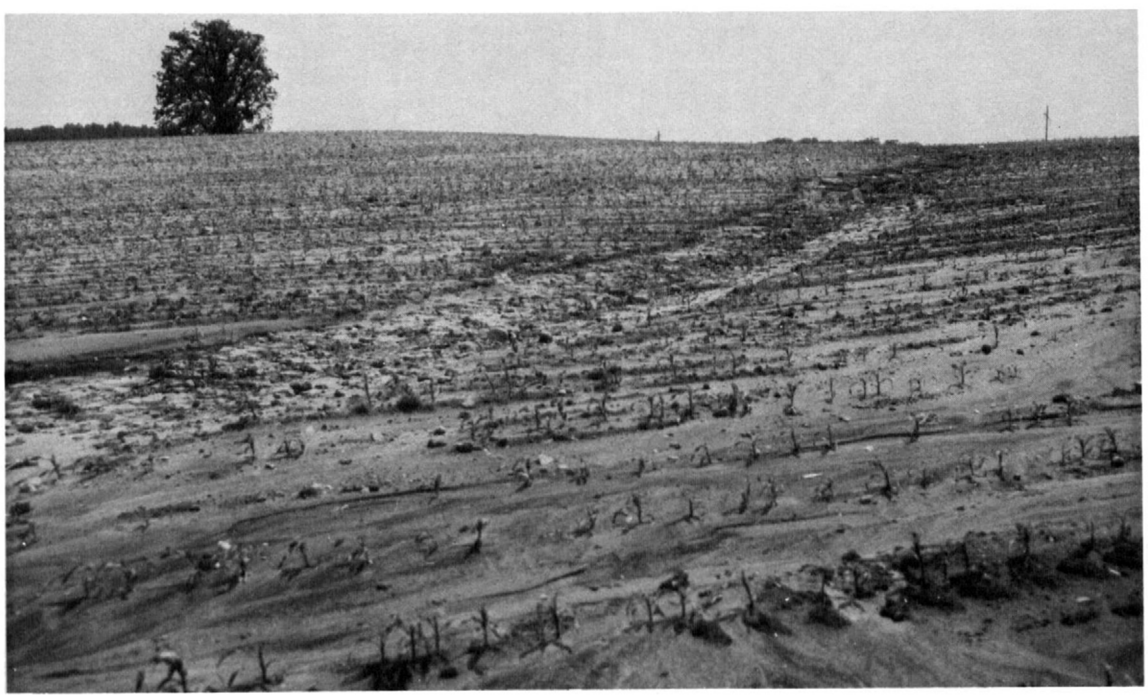

Figure 11.—Soil erosion is a major hazard on Miami, Morley, and Wawasee soils.

Figure 12.—This farm pond on Morley soils provides recreation, livestock water, erosion and flood control, and wildlife habitat.

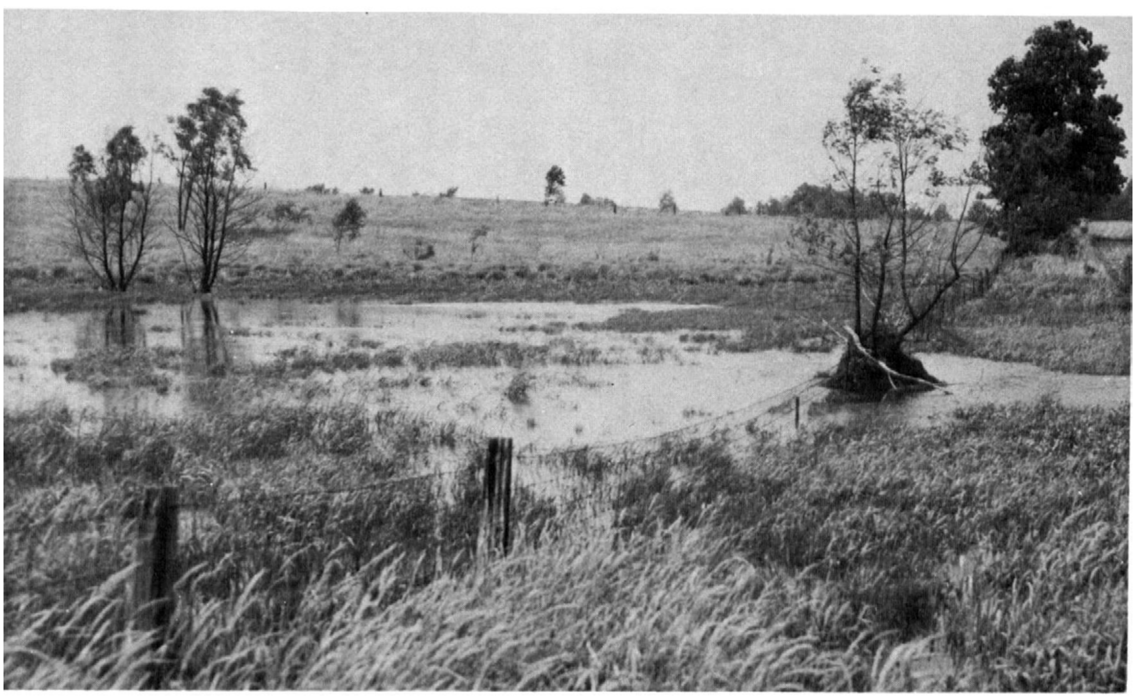

Figure 13.—Shallow water areas that provide wetland wildlife habitat are common on Houghton, Palms, Brookston, Pewamo, and Rensselaer soils.

Figure 14.—Profile of Fox silt loam. Gravel content increases with depth.

Figure 15.—Profile of Millsdale silty clay loam. Bedrock is at a depth of about 2½ feet.

TABLES

TABLE 1.--TEMPERATURE AND PRECIPITATION DATA

Month	Temperature[1]						Precipitation[1]				
	Average daily high	Average daily low	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[2]	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----	33.2	15.3	24.3	60	-15	13	2.20	.96	3.20	7	6.1
February---	36.4	17.4	26.9	61	-10	12	1.83	.87	2.61	5	7.4
March------	45.7	25.5	35.6	77	2	75	2.76	1.74	3.68	8	5.2
April------	60.2	36.9	48.6	84	18	268	4.00	2.15	5.51	9	.8
May--------	71.4	46.8	59.1	91	28	592	3.74	2.74	4.67	8	.0
June-------	81.0	56.6	68.8	96	38	864	4.08	2.57	5.44	8	.0
July-------	84.4	60.1	72.3	96	44	1,001	3.92	2.19	5.32	7	.0
August-----	82.7	57.4	70.1	94	41	933	3.77	2.16	5.07	6	.0
September--	77.2	50.0	63.6	94	31	708	3.10	1.36	4.50	6	.0
October----	66.3	39.1	52.7	87	21	402	2.53	.87	3.85	5	.0
November---	49.8	30.0	39.9	74	10	89	2.71	1.75	3.58	7	1.9
December---	37.1	20.2	28.7	65	-9	33	2.56	.95	3.85	6	7.8
Year-----	60.5	37.9	49.2	98	-18	4,990	37.20	32.46	41.76	82	29.2

[1]Recorded in the period 1951-74 at Wabash, Ind.

[2]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Temperature[1] 24°F or lower	28°F or lower	32°F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 22	May 11	May 27
2 years in 10 later than--	April 17	May 4	May 21
5 years in 10 later than--	April 7	April 22	May 8
First freezing temperature in fall:			
1 year in 10 earlier than--	October 18	October 1	September 20
2 years in 10 earlier than--	October 22	October 7	September 25
5 years in 10 earlier than--	October 29	October 19	October 5

[1]Recorded in the period 1951-74 at Wabash, Ind.

TABLE 3.--GROWING SEASON LENGTH

Probability	Daily minimum temperature during growing season[1]: Higher than 24°F	Higher than 28°F	Higher than 32°F
	Days	Days	Days
9 years in 10	183	154	127
8 years in 10	190	163	134
5 years in 10	205	179	149
2 years in 10	219	195	163
1 year in 10	226	204	171

[1]Recorded in the period 1951-74 at Wabash, Ind.

TABLE 4.--POTENTIAL AND LIMITATIONS OF GENERAL SOIL MAP UNITS FOR SPECIFIED USES

Map unit	Percentage of county	Cultivated crops	Woodland	Urban uses	Intensive recreation areas	Extensive recreation areas
Fincastle-Treaty	8	Good	Good	Poor: wetness.	Fair: wetness.	Good.
Blount-Pewamo	31	Good	Good	Poor: wetness, percs slowly.	Fair: wetness.	Good.
Morley-Hennepin	14	Poor: slope.	Good	Poor: slope, percs slowly.	Fair: slope.	Good.
Gessie-Shoals	8	Good	Good	Poor: floods.	Good	Good.
Fox-Oshtemo	8	Fair: droughty.	Good	Good	Good	Good.
Morley-Blount-Pewamo	17	Fair: slope.	Good	Poor: wetness, percs slowly.	Fair: slope, wetness.	Good.
Wawasee-Crosier-Brookston	14	Good	Good	Poor: wetness.	Fair: wetness.	Good.

TABLE 5.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Au	Aubbeenaubbee sandy loam, 0 to 2 percent slopes	880	0.4
Ba	Blount loam, 1 to 3 percent slopes	6,550	2.7
Bc	Blount silt loam, 0 to 2 percent slopes	50,100	20.6
Br	Brookston loam	4,670	1.9
ChB	Chelsea fine sand, 2 to 9 percent slopes	1,470	0.6
Cr	Crosier loam, 0 to 2 percent slopes	5,000	2.1
Fn	Fincastle silt loam, 0 to 2 percent slopes	9,100	3.7
FsA	Fox silt loam, 0 to 2 percent slopes	4,050	1.7
FsB	Fox silt loam, 2 to 6 percent slopes	1,050	0.4
FzC3	Fox clay loam, 8 to 15 percent slopes, severely eroded	900	0.4
Ge	Gessie silt loam	7,240	3.0
Gr	Gilford sandy loam	1,220	0.5
HeG	Hennepin silt loam, 25 to 50 percent slopes	4,500	1.9
Hx	Houghton muck, drained	3,860	1.6
MaA	Martinsville sandy loam, 0 to 2 percent slopes	730	0.3
MeB	Metea loamy fine sand, 2 to 6 percent slopes	3,400	1.4
MhB	Miami silt loam, 2 to 6 percent slopes	1,310	0.5
MhC3	Miami clay loam, 6 to 12 percent slopes, severely eroded	320	0.1
MhD3	Miami clay loam, 12 to 18 percent slopes, severely eroded	220	0.1
Mk	Milford silty clay	910	0.4
Mm	Millsdale silty clay loam	500	0.2
Mp	Milton silt loam, 0 to 2 percent slopes	295	0.1
MrB	Morley sandy loam, 2 to 6 percent slopes	1,160	0.5
MsB	Morley silt loam, 2 to 6 percent slopes	28,000	11.5
MsC	Morley silt loam, 6 to 12 percent slopes	2,160	0.9
MsD	Morley silt loam, 12 to 18 percent slopes	1,030	0.4
MtC3	Morley silty clay loam, 6 to 12 percent slopes, severely eroded	12,760	5.2
MtD3	Morley silty clay loam, 12 to 25 percent slopes, severely eroded	3,230	1.3
OcA	Ockley silt loam, 0 to 2 percent slopes	2,280	0.9
OcB	Ockley silt loam, 2 to 6 percent slopes	860	0.4
Or	Orthents, loamy	1,000	0.4
OsB	Ormas-Oshtemo loamy sands, 2 to 8 percent slopes	1,965	0.8
OtA	Oshtemo sandy loam, 0 to 4 percent slopes	5,160	2.1
Pm	Palms muck, drained	1,520	0.6
Pt	Patton silty clay loam	900	0.4
Pw	Pewamo silty clay loam	32,100	13.2
Pz	Pits, quarry, limestone	40	*
Re	Rensselaer loam	4,500	1.9
Ro	Ross loam	940	0.4
Se	Sebewa loam	950	0.4
Sh	Shoals silt loam	9,600	3.9
Sn	Sleeth loam	1,480	0.6
So	Sloan silty clay loam	1,770	0.7
St	Stonelick sandy loam	1,100	0.5
Tr	Treaty silt loam	7,430	3.1
Wh	Washtenaw silt loam	1,800	0.7
WsB	Wawasee sandy loam, 2 to 6 percent slopes	6,795	2.8
WsC	Wawasee sandy loam, 6 to 12 percent slopes	800	0.3
WsC3	Wawasee loam, 6 to 12 percent slopes, severely eroded	2,070	0.9
WsD3	Wawasee loam, 12 to 18 percent slopes, severely eroded	530	0.2
	Water	995	0.4
	Total	243,200	100.0

* Less than 0.1 percent.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Corn	Soybeans	Winter wheat	Grass-legume hay	Tall fescue
	Bu	Bu	Bu	Ton	AUM*
Au------------------------- Aubbeenaubbee	110	38	50	3.6	7.2
Ba, Bc--------------------- Blount	100	34	42	4.0	6.6
Br------------------------- Brookston	130	42	50	4.5	9.0
ChB------------------------ Chelsea	60	20	29	3.0	6.0
Cr------------------------- Crosier	115	40	36	3.8	7.6
Fn------------------------- Fincastle	120	40	45	4.3	8.6
FsA------------------------ Fox	90	32	45	4.0	8.0
FsB------------------------ Fox	85	30	42	3.8	7.6
FzC3----------------------- Fox	65	20	30	3.0	6.0
Ge------------------------- Gessie	120	42	48	4.5	9.0
Gr------------------------- Gilford	110	38	45	4.0	8.0
HeG------------------------ Hennepin	---	---	---	---	---
Hx------------------------- Houghton	110	34	---	---	---
MaA------------------------ Martinsville	105	30	40	3.8	7.6
MeB------------------------ Metea	85	30	42	3.5	7.0
MhB------------------------ Miami	105	38	47	4.0	8.0
MhC3----------------------- Miami	80	25	45	3.5	7.0
MhD3----------------------- Miami	65	22	32	3.0	6.0
Mk------------------------- Milford	125	40	45	4.4	8.8
Mm------------------------- Millsdale	110	37	45	4.0	8.0
Mp------------------------- Milton	85	30	40	4.0	8.0

See footnote at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Winter wheat	Grass-legume hay	Tall fescue
	Bu	Bu	Bu	Ton	AUM*
MrB, MsB------------------ Morley	90	33	41	3.6	7.2
MsC---------------------- Morley	82	28	36	3.4	6.8
MsD---------------------- Morley	72	---	30	3.0	6.0
MtC3--------------------- Morley	68	---	26	2.6	5.2
MtD3--------------------- Morley	---	---	---	2.5	5.0
OcA---------------------- Ockley	110	38	46	4.5	9.0
OcB---------------------- Ockley	105	37	42	4.4	8.8
Or**. Orthents					
OsB---------------------- Ormas	70	24	30	3.2	6.4
OtA---------------------- Oshtemo	80	26	35	3.5	7.0
Pm----------------------- Palms	110	35	---	---	---
Pt----------------------- Patton	140	45	50	5.0	---
Pw----------------------- Pewamo	120	46	50	4.3	8.6
Pz**. Pits					
Re----------------------- Rensselaer	140	46	50	4.5	9.0
Ro***-------------------- Ross	120	42	48	4.5	9.0
Se----------------------- Sebewa	115	40	45	4.0	8.0
Sh----------------------- Shoals	105	40	52	4.3	8.6
Sn----------------------- Sleeth	120	40	45	4.0	8.0
So----------------------- Sloan	100	42	45	4.0	8.0
St----------------------- Stonelick	90	30	35	3.5	7.0
Tr----------------------- Treaty	140	45	55	4.8	9.6
Wh----------------------- Washtenaw	130	46	52	4.3	8.6

See footnotes at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Winter wheat	Grass-legume hay	Tall fescue
	Bu	Bu	Bu	Ton	AUM*
WsB----------------------- Wawasee	100	35	45	3.8	7.6
WsC, WsC3----------------- Wawasee	90	32	40	3.7	7.4
WsD3---------------------- Wawasee	70	24	32	3.0	6.0

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.
** See description of the map unit for composition and behavior characteristics of the map unit.
*** Yields are for areas protected from flooding.

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	11,190	---	---	---	---
II	183,330	39,175	138,710	5,445	---
III	21,085	6,360	6,130	8,595	---
IV	17,080	17,080	---	---	---
V	---	---	---	---	---
VI	4,980	4,980	---	---	---
VII	4,500	4,500	---	---	---
VIII	---	---	---	---	---

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available]

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Trees to plant
Au------------------ Aubbeenaubbee	3o	Slight	Slight	Slight	Slight	White oak----------- Pin oak------------- Yellow-poplar------- Northern red oak----	75 85 85 75	Eastern white pine, white ash, red maple, yellow-poplar, American sycamore, green ash.
Ba, Bc-------------- Blount	3o	Slight	Slight	Slight	Slight	White oak----------- Northern red oak---- Green ash----------- Bur oak------------- Pin oak-------------	65 65 --- --- ---	Eastern white pine, Scotch pine, eastern redcedar, red pine, yellow-poplar.
Br------------------ Brookston	2w	Slight	Severe	Severe	Moderate	Pin oak------------- White oak----------- Northern red oak----	85 75 75	Eastern white pine, Norway spruce, red maple, white ash.
ChB----------------- Chelsea	3s	Slight	Slight	Moderate	Slight	White oak----------- Eastern white pine--	65 60	Eastern white pine, Scotch pine, European larch, eastern redcedar, red pine, jack pine.
Cr------------------ Crosier	3o	Slight	Slight	Slight	Slight	White oak----------- Pin oak------------- Yellow-poplar------- Northern red oak----	75 85 85 75	Eastern white pine, white ash, red maple, yellow-poplar, American sycamore.
Fn------------------ Fincastle	3o	Slight	Slight	Slight	Slight	Northern red oak---- White oak----------- Pin oak------------- Yellow-poplar-------	75 75 85 85	Eastern white pine, white ash, red maple, yellow-poplar, American sycamore.
FsA, FsB, FzC3------ Fox	2o	Slight	Slight	Slight	Slight	Northern red oak---- White oak----------- Sugar maple---------	80 --- ---	Yellow-poplar, white ash, eastern white pine, red pine, black locust.
Ge------------------ Gessie	1o	Slight	Slight	Slight	Slight	Yellow-poplar-------	100	Eastern white pine, black walnut, black locust, eastern cottonwood, yellow-poplar.
Gr------------------ Gilford	4w	Slight	Severe	Severe	Severe	Pin oak------------- Eastern white pine-- Bigtooth aspen------ Red maple-----------	70 75 70 70	Eastern white pine, European larch, white spruce, white ash.

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	Trees to plant
HeG---------------- Hennepin	1r	Severe	Severe	Slight	Slight	Northern red oak---- White oak-----------	88 ---	Northern red oak, white oak, green ash, black walnut, eastern white pine, red pine, eastern redcedar.
Hx----------------- Houghton	3w	Slight	Severe	Severe	Severe	Red maple----------- Silver maple-------- White ash----------- Quaking aspen------- Tamarack------------ Green ash----------- Northern white-cedar	51 76 51 56 45 --- 27	
MaA---------------- Martinsville	1o	Slight	Slight	Slight	Slight	White oak----------- Yellow-poplar-------	90 98	Eastern white pine, red pine, white ash, yellow-poplar, black walnut, black locust.
MeB---------------- Metea	2s	Slight	Slight	Moderate	Slight	White oak----------- Yellow-poplar------- Eastern white pine-- Red pine------------	80 80 85 75	Eastern white pine, red pine, yellow-poplar, black walnut, European alder.
MhB, MhC3, MhD3---- Miami	1o	Slight	Slight	Slight	Slight	White oak----------- Yellow-poplar-------	90 98	Eastern white pine, red pine, white ash, yellow-poplar, black walnut, black locust.
Mk----------------- Milford	---	--------	--------	--------	--------	-------------------	---	Pin oak, green ash, eastern hemlock, Norway spruce, red maple.
Mm----------------- Millsdale	2w	Slight	Severe	Severe	Severe	Pin oak-------------	86	Eastern white pine, white ash, red maple.
Mp----------------- Milton	2o	Slight	Slight	Slight	Slight	Northern red oak---- Yellow-poplar------- Black walnut-------- Black cherry--------	80 95 --- ---	Eastern white pine, black walnut, yellow-poplar.
MrB, MsB, MsC, MsD- Morley	2o	Slight	Slight	Slight	Slight	White oak----------- Northern red oak---- Yellow-poplar------- Black walnut-------- Bur oak------------- Northern red oak---- Shagbark hickory----	80 80 90 --- --- --- ---	White oak, black walnut, green ash, eastern white pine, Norway spruce, red pine, white spruce.
MtC3, MtD3--------- Morley	2o	Slight	Slight	Slight	Slight	White oak----------- Northern red oak---- Yellow-poplar------- Black walnut-------- Bur oak------------- Northern red oak---- Shagbark hickory----	80 80 90 --- --- --- ---	White oak, black walnut, green ash, eastern white pine, Norway spruce, red pine, white spruce.

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	Trees to plant
OcA, OcB: Ockley	1o	Slight	Slight	Slight	Slight	White oak Northern red oak Yellow-poplar	90 90 98	Eastern white pine, red pine, white ash, yellow-poplar, black walnut, black locust.
OsB*: Ormas	3s	Slight	Slight	Moderate	Slight	White oak Yellow-poplar Eastern white pine Red pine	70 --- --- 78	Eastern white pine, red pine, yellow-poplar, black walnut, European alder.
Oshtemo	3s	Slight	Slight	Slight	Slight	White oak Red pine Eastern white pine Jack pine	70 78 85 68	Eastern white pine, red pine, jack pine.
OtA: Oshtemo	3o	Slight	Slight	Slight	Slight	White oak Red pine Eastern white pine Jack pine	70 78 85 68	Eastern white pine, red pine, jack pine.
Pm: Palms	4w	Slight	Severe	Severe	Severe	Red maple Silver maple White ash Quaking aspen Northern white-cedar Tamarack Black ash	51 76 51 56 27 45 ---	
Pt: Patton	2w	Slight	Severe	Moderate	Moderate	Pin oak White oak Northern red oak	86 75 75	Eastern white pine, Norway spruce, red maple, white ash, sweetgum.
Pw: Pewamo	2w	Slight	Severe	Moderate	Moderate	Red maple American basswood Pin oak Silver maple Bur oak Bitternut hickory Black ash Eastern cottonwood	66 --- 86 --- --- --- --- ---	Eastern cottonwood, black spruce, white ash, eastern white pine, white spruce, Norway spruce, red maple.
Re: Rensselaer	2w	Slight	Severe	Severe	Severe	Pin oak White oak Northern red oak	87 75 80	Eastern white pine, Norway spruce, red maple, white ash.
Ro: Ross	1o	Slight	Slight	Slight	Slight	Northern red oak Yellow-poplar Sugar maple	88 97 85	Eastern white pine, black walnut, white ash, Norway spruce, yellow-poplar.
Se: Sebewa	2w	Slight	Severe	Moderate	Moderate	Red maple White ash American basswood Black spruce Pin oak Northern red oak	85 --- --- --- 87 75	White spruce, eastern white pine, northern white-cedar, Norway spruce, white ash, red maple.

See footnote at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Trees to plant
Sh	2o	Slight	Slight	Slight	Slight	Pin oak	90	Red maple, swamp chestnut oak, pin oak, yellow-poplar.
						Yellow-poplar	90	
						Virginia pine	90	
						Eastern cottonwood	---	
						White ash	---	
Sn: Sleeth	3o	Slight	Slight	Slight	Slight	Pin oak	85	Eastern white pine, white ash, red maple, yellow-poplar, American sycamore.
						Yellow-poplar	85	
						White oak	75	
So: Sloan	2w	Slight	Severe	Severe	Severe	Pin oak	87	Norway spruce, red maple, white ash.
						Swamp white oak	---	
						Red maple	---	
St: Stonelick	2o	Slight	Slight	Slight	Slight	Northern red oak	80	Eastern white pine, black walnut, yellow-poplar.
Tr: Treaty	2w	Slight	Severe	Severe	Severe	Pin oak	90	Eastern white pine, Norway spruce, red maple, white ash.
						White oak	75	
						Northern red oak	---	
Wh: Washtenaw	2w	Slight	Severe	Severe	Moderate	Pin oak	86	Eastern white pine, Norway spruce, red maple, white ash, white spruce, black spruce.
						Northern red oak	80	
						Red maple	70	
						Silver maple	---	
						White ash	---	
						American basswood	---	
						White oak	---	
WsB, WsC, WsC3, WsD3: Wawasee	1o	Slight	Slight	Slight	Slight	White oak	90	Eastern white pine, red pine, white ash, yellow-poplar, black walnut, black locust.
						Yellow-poplar	98	

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Au: Aubbeenaubbee	---	Autumn-olive, Amur honeysuckle, blackhaw, mapleleaf viburnum, cornelian cherry dogwood, American cranberrybush, shadblow serviceberry, rose-of-sharon.	---	Norway spruce, white spruce, American basswood.	Eastern white pine.
Ba, Bc: Blount	---	Autumn-olive, Amur honeysuckle, cornelian cherry dogwood, American cranberrybush, blackhaw, arrowwood, rose-of-sharon.	Norway spruce	White spruce	Eastern white pine, American basswood.
Br: Brookston	Gray dogwood, dwarf purple willow.	Redosier dogwood, Amur honeysuckle, silky dogwood.	Northern white-cedar, medium purple willow, tall purple willow, Siberian crabapple.	---	Green ash, Lombardy poplar.
ChB. Chelsea					
Cr: Crosier	Cutleaf staghorn sumac.	Blackhaw, autumn-olive, Amur honeysuckle, mapleleaf viburnum, cornelian cherry dogwood, American cranberrybush, rose-of-sharon.	---	Norway spruce, American basswood, white spruce.	Eastern white pine.
Fn: Fincastle	Cutleaf staghorn sumac.	Blackhaw, arrowwood, cornelian cherry dogwood, rose-of-sharon, Amur honeysuckle, American cranberrybush, autumn-olive.	---	American basswood, Norway spruce, white spruce.	Eastern white pine.
FsA, FsB, FzC3: Fox	---	Autumn-olive, Amur honeysuckle, blackhaw, shadblow serviceberry, American cranberrybush, cornelian cherry dogwood.	---	Norway spruce, white spruce, American basswood.	Eastern white pine.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Ge: Gessie	Mockorange	European burningbush, black hawthorn, late lilac, Amur honeysuckle, shadblow serviceberry, American cranberrybush, autumn-olive.	Eastern hemlock	Norway spruce	Eastern white pine, honeylocust.
Gr: Gilford	Gray dogwood, dwarf purple willow.	Redosier dogwood, hawthorn, silky dogwood, shadblow serviceberry.	Northern white-cedar, tall purple willow, laurel willow.	Pin oak, eastern white pine.	Lombardy poplar.
HeG: Hennepin	---	European burningbush, blackhaw, late lilac, Amur honeysuckle, autumn-olive.	Eastern hemlock	Norway spruce	Honeylocust, eastern white pine.
Hx: Houghton	Gray dogwood, dwarf purple willow.	Amur honeysuckle, redosier dogwood, silky dogwood.	Northern white-cedar, tall purple willow, medium purple willow.	---	Lombardy poplar.
MaA: Martinsville	Mockorange	European burningbush, blackhaw, late lilac, Amur honeysuckle, shadblow serviceberry, American cranberrybush, autumn-olive.	Eastern hemlock	Norway spruce	Eastern white pine, honeylocust.
MeB: Metea	American hazel, European privet.	Forsythia, late lilac, tamarisk, autumn-olive.	---	Red pine, eastern white pine, jack pine, Austrian pine.	---
MhB, MhC3, MhD3: Miami	---	Blackhaw, late lilac, Amur honeysuckle, shadblow serviceberry, winged euonymus, American cranberrybush, autumn-olive.	Eastern hemlock, European burningbush.	Norway spruce	Eastern white pine, honeylocust.
Mk: Milford	Gray dogwood	Silky dogwood, forsythia, redosier dogwood, northern white-cedar, Amur honeysuckle.	Black spruce, Amur maple, tall purple willow, medium purple willow.	---	Eastern cottonwood, Lombardy poplar.
Mm: Millsdale	---	Redosier dogwood, silky dogwood, gray dogwood.	Poplar, northern white-cedar, black willow, medium purple willow, European alder.	---	---

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
Mp: Milton	---	Tatarian honeysuckle, forsythia, hawthorn, nannyberry viburnum, autumn-olive, winged euonymus.	Norway spruce, Scotch pine, red pine.	Poplar, eastern white pine, Austrian pine.	---
MrB, MsB, MsC, MsD, MtC3, MtD3: Morley	Mockorange	Amur honeysuckle, autumn-olive, late lilac, blackhaw, American cranberrybush.	Eastern redcedar	Eastern white pine, Norway spruce, red pine, Douglas-fir, eastern hemlock.	---
OcA, OcB: Ockley	---	Autumn-olive, American cranberrybush, late lilac, Tatarian honeysuckle.	White spruce	Eastern white pine, Norway spruce.	Carolina poplar.
Or*. Orthents					
OsB*:					
Ormas	American hazel, European privet.	Tamarisk, late lilac, forsythia, autumn-olive.	---	Eastern white pine, red pine, Austrian pine, jack pine.	---
Oshtemo	American hazel, European privet.	Tamarisk, late lilac, forsythia, autumn-olive.	---	Eastern white pine, red pine, Austrian pine, jack pine.	---
OtA: Oshtemo	American hazel, European privet.	Tamarisk, late lilac, forsythia, autumn-olive.	---	Eastern white pine, red pine, Austrian pine, jack pine.	---
Pm: Palms	Gray dogwood, dwarf purple willow.	Amur honeysuckle, redosier dogwood, silky dogwood.	Northern white-cedar, tall purple willow, medium purple willow.	---	Lombardy poplar.
Pt: Patton	---	Silky dogwood, redosier dogwood.	Amur maple, northern white-cedar, tall purple willow, medium purple willow.	---	American sycamore, Lombardy poplar.
Pw: Pewamo	Gray dogwood, dwarf purple willow.	Amur honeysuckle, redosier dogwood, silky dogwood.	Northern white-cedar, tall purple willow, medium purple willow.	---	Lombardy poplar.
Pz*. Pits					
Re: Rensselaer	Gray dogwood, dwarf purple willow.	Redosier dogwood, Amur honeysuckle, silky dogwood.	Northern white-cedar, medium purple willow, tall purple willow.	---	Lombardy poplar.

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Ro. Ross	Mockorange	European burningbush, blackhaw, late lilac, Amur honeysuckle, shadblow serviceberry, American cranberrybush, autumn-olive.	Eastern hemlock	Norway spruce	Honeylocust, eastern white pine.
Se. Sebewa	Gray dogwood, dwarf purple willow.	Amur honeysuckle, redosier dogwood, silky dogwood.	Northern white-cedar, tall purple willow, medium purple willow.	---	Lombardy poplar.
Sh. Shoals	Gray dogwood, dwarf purple willow.	Redosier dogwood, silky dogwood, Amur honeysuckle.	Northern white-cedar, medium purple willow, tall purple willow.	---	Lombardy poplar.
Sn. Sleeth	Cutleaf staghorn sumac.	Blackhaw, arrowwood, cornelian cherry dogwood, rose-of-sharon, Amur honeysuckle, American cranberrybush, autumn-olive.	White spruce	American basswood, Norway spruce.	Eastern white pine.
So. Sloan	---	Redosier dogwood, silky dogwood, gray dogwood.	Poplar, northern white-cedar, black willow, medium purple willow, European alder.	---	---
St. Stonelick	Mockorange	European burningbush, blackhaw, late lilac, Amur honeysuckle, shadblow serviceberry, American cranberrybush, autumn-olive.	Eastern hemlock	Norway spruce	Honeylocust, eastern white pine.
Tr. Treaty	Gray dogwood, dwarf purple willow.	Amur honeysuckle, redosier dogwood, silky dogwood.	Northern white-cedar, tall purple willow, medium purple willow.	---	Lombardy poplar.
Wh. Washtenaw	Gray dogwood, dwarf purple willow.	Redosier dogwood, silky dogwood, Amur honeysuckle.	Northern white-cedar, medium purple willow, tall purple willow.	---	Lombardy poplar.
WsB, WsC, WsC3, WsD3. Wawasee	---	Blackhaw, late lilac, Amur honeysuckle, shadblow serviceberry, winged euonymus, American cranberrybush, autumn-olive.	Eastern hemlock, European burningbush.	Norway spruce	Honeylocust, eastern white pine.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Au: Aubbeenaubbee	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, wetness, low strength.
Ba, Bc: Blount	Severe: wetness.	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: frost action, low strength.
Br: Brookston	Severe: wetness, floods.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, low strength, floods.
ChB: Chelsea	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
Cr: Crosier	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, low strength.
Fn: Fincastle	Severe: wetness.	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: frost action, low strength, wetness.
FsA: Fox	Severe: cutbanks cave.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.
FsB: Fox	Severe: cutbanks cave.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: low strength.
FzC3: Fox	Severe: cutbanks cave.	Moderate: slope, shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: slope.	Severe: low strength.
Ge: Gessie	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: low strength, floods, frost action.
Gr: Gilford	Severe: wetness, cutbanks cave, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, frost action, floods.
HeG: Hennepin	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, low strength.
Hx: Houghton	Severe: wetness, floods, excess humus.	Severe: wetness, floods, low strength.	Severe: wetness, low strength, floods.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.
MaA: Martinsville	Slight	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
MeB------------- Metea	Severe: cutbanks cave.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Moderate: frost action.
MhB------------- Miami	Slight-----------	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Moderate: low strength, frost action.
MhC3------------ Miami	Moderate: slope.	Moderate: slope, shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: slope.	Moderate: low strength, slope, frost action.
MhD3------------ Miami	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Mk-------------- Milford	Severe: wetness, floods.	Severe: wetness, shrink-swell, floods.	Severe: wetness, shrink-swell, floods.	Severe: wetness, shrink-swell, floods.	Severe: low strength, wetness, floods.
Mm-------------- Millsdale	Severe: wetness, depth to rock.	Severe: wetness, shrink-swell, low strength.	Severe: wetness, depth to rock, shrink-swell.	Severe: wetness, shrink-swell, low strength.	Severe: low strength, wetness, frost action.
Mp-------------- Milton	Severe: depth to rock.	Moderate: depth to rock, shrink-swell.	Severe: depth to rock.	Moderate: depth to rock, shrink-swell.	Severe: low strength.
MrB, MsB-------- Morley	Moderate: too clayey, wetness.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell, low strength, slope.	Severe: low strength.
MsC------------- Morley	Moderate: too clayey, slope.	Moderate: shrink-swell, low strength, slope.	Moderate: slope, shrink-swell, wetness.	Severe: slope.	Severe: low strength.
MsD------------- Morley	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
MtC3------------ Morley	Moderate: too clayey, slope.	Moderate: shrink-swell, low strength, slope.	Moderate: slope, shrink-swell, wetness.	Severe: slope.	Severe: low strength.
MtD3------------ Morley	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
OcA------------- Ockley	Severe: cutbanks cave.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.
OcB------------- Ockley	Severe: cutbanks cave.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
Or*. Orthents					

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
OsB*:					
Ormas	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.
Oshtemo	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
OtA Oshtemo	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
Pm Palms	Severe: wetness, excess humus, floods.	Severe: wetness, low strength, floods.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.
Pt Patton	Severe: wetness.	Severe: wetness, low strength, floods.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, frost action, low strength.
Pw Pewamo	Severe: wetness, floods.	Severe: floods, wetness, low strength.	Severe: floods, wetness, low strength.	Severe: floods, wetness, low strength.	Severe: low strength, floods, wetness.
Pz*. Pits					
Re Rensselaer	Severe: wetness, cutbanks cave, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, frost action, low strength.
Ro Ross	Moderate: wetness.	Moderate: low strength.	Moderate: wetness, low strength.	Moderate: low strength.	Severe: low strength.
Se Sebewa	Severe: wetness, cutbanks cave, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, low strength, floods.
Sh Shoals	Severe: wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: frost action.
Sn Sleeth	Severe: wetness, cutbanks cave.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, low strength.
So Sloan	Severe: wetness, floods.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: wetness, floods, frost action.
St Stonelick	Severe: floods, cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
Tr Treaty	Severe: wetness, floods.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: wetness, low strength, floods.
Wh Washtenaw	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, frost action, floods.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
WsB: Wawasee	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength, frost action.
WsC, WsC3: Wawasee	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, slope, frost action.
WsD3: Wawasee	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Au------------------ Aubbeenaubbee	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, seepage.	Poor: wetness.
Ba, Bc-------------- Blount	Severe: wetness, percs slowly.	Slight-----------	Severe: wetness.	Severe: wetness.	Poor: wetness.
Br------------------ Brookston	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
ChB----------------- Chelsea	Slight-----------	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
Cr------------------ Crosier	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Good.
Fn------------------ Fincastle	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
FsA, FsB------------ Fox	Slight-----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: too sandy, seepage.
FzC3---------------- Fox	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: too sandy, seepage.
Ge------------------ Gessie	Moderate: floods.	Severe: floods.	Moderate: floods.	Moderate: floods.	Good.
Gr------------------ Gilford	Severe: wetness, floods.	Severe: wetness, seepage, floods.	Severe: wetness, seepage, floods.	Severe: wetness, seepage, floods.	Poor: wetness.
HeG----------------- Hennepin	Severe: slope, percs slowly.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Hx------------------ Houghton	Severe: wetness, floods.	Severe: wetness, seepage, floods.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Poor: hard to pack, wetness.
MaA----------------- Martinsville	Slight-----------	Moderate: seepage.	Slight-----------	Slight-----------	Fair: too clayey.
MeB----------------- Metea	Severe: percs slowly.	Severe: seepage.	Slight-----------	Severe: seepage.	Fair: too clayey.
MhB----------------- Miami	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
MhC3---------------- Miami	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: slope, too clayey.

TABLE 11.--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
MhD3: Miami	Severe: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Severe: slope.	Poor: slope.
Mk: Milford	Severe: wetness, percs slowly, floods.	Severe: floods, wetness.	Severe: wetness, floods, too clayey.	Severe: wetness, floods.	Poor: wetness, too clayey.
Mm: Millsdale	Severe: wetness, percs slowly, depth to rock.	Severe: wetness, depth to rock.	Severe: depth to rock, wetness, too clayey.	Severe: wetness.	Poor: wetness, too clayey, area reclaim.
Mp: Milton	Severe: depth to rock, wetness.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: area reclaim, thin layer.
MrB, MsB: Morley	Severe: percs slowly, wetness.	Severe: wetness.	Moderate: too clayey, wetness.	Slight	Fair: too clayey.
MsC: Morley	Severe: percs slowly, wetness.	Severe: slope, wetness.	Moderate: too clayey, wetness.	Moderate: slope.	Fair: too clayey, slope.
MsD: Morley	Severe: percs slowly, slope, wetness.	Severe: slope, wetness.	Moderate: slope, too clayey, wetness.	Severe: slope.	Poor: slope.
MtC3: Morley	Severe: percs slowly, wetness.	Severe: slope, wetness.	Moderate: too clayey, wetness.	Moderate: slope.	Fair: too clayey, slope.
MtD3: Morley	Severe: percs slowly, slope, wetness.	Severe: slope, wetness.	Moderate: slope, too clayey, wetness.	Severe: slope.	Poor: slope.
OcA, OcB: Ockley	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too clayey.
Or*. Orthents					
OsB*:					
Ormas	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: seepage.
Oshtemo	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy, seepage.
OtA: Oshtemo	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy, seepage.
Pm: Palms	Severe: wetness, floods, subsides.	Severe: wetness, seepage, floods.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Poor: wetness, hard to pack.
Pt: Patton	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.

See footnote at end of table.

TABLE 11.--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
Pw: Pewamo	Severe: percs slowly, floods, wetness.	Severe: wetness.	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: too clayey, wetness.
Pz*. Pits					
Re: Rensselaer	Severe: wetness, percs slowly, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
Ro: Ross	Moderate: wetness.	Moderate: seepage.	Severe: wetness.	Severe: seepage.	Good.
Se: Sebewa	Severe: wetness, floods.	Severe: wetness, seepage.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Poor: wetness, small stones, seepage.
Sh: Shoals	Severe: wetness.	Severe: floods, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Sn: Sleeth	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: wetness.
So: Sloan	Severe: wetness, floods.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
St: Stonelick	Severe: floods.	Severe: floods, seepage.	Severe: floods, seepage.	Severe: floods, seepage.	Fair: too sandy.
Tr: Treaty	Severe: floods, wetness.	Severe: wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
Wh: Washtenaw	Severe: wetness, percs slowly, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
WsB: Wawasee	Slight	Moderate: slope, seepage.	Slight	Slight	Good.
WsC, WsC3: Wawasee	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.	Fair: slope.
WsD3: Wawasee	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and "poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Au-------------------- Aubbeenaubbee	Poor: wetness.	Poor: excess fines, thin layer.	Unsuited: excess fines.	Fair: small stones.
Ba, Bc---------------- Blount	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Br-------------------- Brookston	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
ChB------------------- Chelsea	Good-----------------	Good-----------------	Unsuited: excess fines.	Poor: too sandy.
Cr-------------------- Crosier	Poor: wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Fn-------------------- Fincastle	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
FsA, FsB-------------- Fox	Poor: low strength.	Good-----------------	Good-----------------	Fair: thin layer.
FzC3------------------ Fox	Poor: low strength.	Good-----------------	Good-----------------	Fair: too clayey, slope.
Ge-------------------- Gessie	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Gr-------------------- Gilford	Poor: wetness.	Good-----------------	Unsuited: excess fines.	Poor: wetness.
HeG------------------- Hennepin	Poor: low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
Hx-------------------- Houghton	Poor: wetness, low strength.	Unsuited: excess humus.	Unsuited: excess humus.	Poor: wetness, excess humus.
MaA------------------- Martinsville	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Fair: thin layer.
MeB------------------- Metea	Poor: thin layer.	Poor: thin layer.	Unsuited: excess fines.	Fair: too sandy.
MhB------------------- Miami	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
MhC3------------------ Miami	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, slope.
MhD3------------------ Miami	Fair: low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
Mk-------------------- Milford	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness, too clayey.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Mm: Millsdale	Poor: low strength, wetness, thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
Mp: Milton	Poor: low strength, area reclaim, thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
MrB: Morley	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
MsB: Morley	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
MsC: Morley	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, slope.
MsD: Morley	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Severe: slope.
MtC3: Morley	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, slope.
MtD3: Morley	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Severe: slope.
OcA, OcB: Ockley	Poor: low strength.	Good	Good	Fair: thin layer.
Or*. Orthents				
OsB*:				
Ormas	Good	Good	Poor: excess fines.	Fair: too sandy.
Oshtemo	Good	Good	Good	Fair: too sandy, small stones.
OtA: Oshtemo	Good	Good	Good	Fair: small stones.
Pm: Palms	Poor: wetness, low strength.	Unsuited: excess humus, excess fines.	Unsuited: excess humus, excess fines.	Poor: wetness, excess humus.
Pt: Patton	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
Pw: Pewamo	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
Pz*. Pits				
Re: Rensselaer	Poor: wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
Ro: Ross	Fair: low strength.	Poor: excess fines.	Poor: excess fines.	Good.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Se: Sebewa	Poor: wetness.	Good	Good	Poor: wetness.
Sh: Shoals	Poor: wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Sn: Sleeth	Poor: low strength, wetness.	Good	Good	Fair: thin layer.
So: Sloan	Poor: wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
St: Stonelick	Fair: low strength, frost action.	Fair: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Tr: Treaty	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
Wh: Washtenaw	Poor: wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
WsB: Wawasee	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
WsC, WsC3: Wawasee	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, slope.
WsD3: Wawasee	Fair: low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
Au---------------- Aubbeenaubbee	Seepage---------	Wetness---------	Deep to water, slow refill.	Frost action---	Not needed-----	Wetness.
Ba, Bc------------ Blount	Favorable------	Wetness---------	Deep to water, slow refill.	Percs slowly, frost action.	Not needed-----	Erodes easily, wetness, percs slowly.
Br---------------- Brookston	Favorable------	Wetness---------	Slow refill----	Floods, frost action.	Not needed-----	Wetness.
ChB--------------- Chelsea	Seepage---------	Piping, seepage.	No water-------	Not needed-----	Too sandy, soil blowing.	Droughty.
Cr---------------- Crosier	Favorable------	Piping, wetness.	Deep to water, slow refill.	Frost action---	Not needed-----	Wetness.
Fn---------------- Fincastle	Favorable------	Hard to pack, wetness.	Slow refill----	Frost action---	Not needed-----	Wetness, erodes easily, percs slowly.
FsA--------------- Fox	Seepage---------	Seepage---------	No water-------	Not needed-----	Not needed-----	Favorable.
FsB--------------- Fox	Seepage---------	Seepage---------	No water-------	Not needed-----	Too sandy------	Favorable.
FzC3-------------- Fox	Seepage, slope.	Seepage---------	No water-------	Not needed-----	Too sandy------	Slope.
Ge---------------- Gessie	Seepage---------	Piping----------	No water-------	Not needed-----	Not needed-----	Erodes easily.
Gr---------------- Gilford	Seepage---------	Seepage, wetness.	Favorable------	Floods, frost action.	Not needed-----	Wetness.
HeG--------------- Hennepin	Slope----------	Favorable------	No water-------	Not needed-----	Slope, percs slowly.	Slope, percs slowly.
Hx---------------- Houghton	Seepage---------	Excess humus, wetness.	Favorable------	Frost action, excess humus, floods.	Not needed-----	Wetness.
MaA--------------- Martinsville	Seepage---------	Favorable------	No water-------	Not needed-----	Not needed-----	Erodes easily.
MeB--------------- Metea	Seepage---------	Piping----------	No water-------	Not needed-----	Too sandy, soil blowing.	Favorable.
MhB--------------- Miami	Favorable------	Piping----------	No water-------	Not needed-----	Favorable------	Erodes easily.
MhC3-------------- Miami	Slope----------	Piping----------	No water-------	Not needed-----	Favorable------	Slope, erodes easily.
MhD3-------------- Miami	Slope----------	Piping----------	No water-------	Not needed-----	Slope----------	Slope, erodes easily.
Mk---------------- Milford	Favorable------	Wetness---------	Slow refill----	Floods, frost action.	Not needed-----	Wetness.
Mm---------------- Millsdale	Depth to rock	Wetness, hard to pack, thin layer.	Slow refill----	Depth to rock, frost action.	Depth to rock, wetness.	Wetness, depth to rock.
Mp---------------- Milton	Depth to rock, seepage.	Thin layer-----	No water-------	Not needed-----	Not needed-----	Depth to rock, erodes easily.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
MrB, MsB: Morley	Favorable	Favorable	Deep to water, slow refill.	Not needed	Erodes easily, percs slowly.	Erodes easily, percs slowly.
MsC: Morley	Favorable	Favorable	Deep to water, slow refill.	Not needed	Erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
MsD: Morley	Favorable	Favorable	Deep to water, slow refill.	Not needed	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
MtC3: Morley	Favorable	Favorable	Deep to water, slow refill.	Not needed	Erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
MtD3: Morley	Favorable	Favorable	Deep to water, slow refill.	Not needed	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
OcA: Ockley	Seepage	Thin layer	No water	Not needed	Not needed	Erodes easily.
OcB: Ockley	Seepage	Thin layer	No water	Not needed	Favorable	Erodes easily.
Or*. Orthents						
OsB*:						
Ormas	Seepage	Seepage	No water	Not needed	Too sandy, soil blowing.	Favorable.
Oshtemo	Seepage	Seepage	No water	Not needed	Too sandy, soil blowing.	Favorable.
OtA: Oshtemo	Seepage	Seepage	No water	Not needed	Not needed	Favorable.
Pm: Palms	Seepage	Excess humus, wetness.	Slow refill	Floods, frost action, excess humus.	Not needed	Wetness.
Pt: Patton	Seepage	Wetness	Slow refill	Frost action	Not needed	Wetness.
Pw: Pewamo	Favorable	Wetness, hard to pack.	Slow refill	Floods, frost action.	Not needed	Wetness.
Pz*. Pits						
Re: Rensselaer	Seepage	Wetness	Slow refill	Floods, frost action.	Not needed	Wetness, percs slowly.
Ro: Ross	Seepage	Piping	Deep to water, slow refill.	Not needed	Not needed	Favorable.
Se: Sebewa	Seepage	Seepage, wetness.	Slow refill	Frost action, floods.	Not needed	Wetness.
Sh: Shoals	Seepage	Wetness	Slow refill, deep to water.	Frost action	Not needed	Wetness, erodes easily.
Sn: Sleeth	Seepage	Wetness	Deep to water, slow refill.	Frost action	Not needed	Wetness.
So: Sloan	Favorable	Piping, wetness.	Slow refill	Wetness, floods, frost action.	Not needed	Wetness, erodes easily.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
St: Stonelick	Seepage	Seepage	No water	Not needed	Not needed	Droughty.
Tr: Treaty	Seepage	Wetness	Slow refill	Floods, frost action.	Not needed	Wetness, erodes easily.
Wh: Washtenaw	Seepage	Piping, wetness.	Slow refill	Percs slowly, frost action, floods.	Not needed	Wetness, percs slowly.
WsB: Wawasee	Seepage	Favorable	No water	Not needed	Soil blowing	Favorable.
WsC: Wawasee	Slope, seepage.	Favorable	No water	Not needed	Soil blowing	Slope.
WsC3: Wawasee	Slope, seepage.	Favorable	No water	Not needed	Favorable	Slope.
WsD3: Wawasee	Slope, seepage.	Favorable	No water	Not needed	Slope	Slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--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
Au: Aubbeenaubbee	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
Ba, Bc: Blount	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
Br: Brookston	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.
ChB: Chelsea	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
Cr: Crosier	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
Fn: Fincastle	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
FsA: Fox	Slight	Slight	Slight	Slight.
FsB: Fox	Slight	Slight	Moderate: slope.	Slight.
FzC3: Fox	Moderate: too clayey, slope.	Moderate: too clayey, slope.	Severe: slope.	Moderate: too clayey.
Ge: Gessie	Severe: floods.	Slight	Slight	Slight.
Gr: Gilford	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.
HeG: Hennepin	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Hx: Houghton	Severe: wetness, floods, excess humus.	Severe: wetness, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, excess humus.
MaA: Martinsville	Slight	Slight	Slight	Slight.
MeB: Metea	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.
MhB: Miami	Moderate: percs slowly.	Slight	Moderate: percs slowly, slope.	Slight.
MhC3: Miami	Moderate: percs slowly, slope.	Moderate: slope, too clayey.	Severe: slope.	Moderate: too clayey.
MhD3: Miami	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too clayey, slope.

TABLE 14.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Mk: Milford	Severe: wetness, too clayey, floods.	Severe: wetness, too clayey.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
Mm: Millsdale	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Mp: Milton	Moderate: percs slowly.	Slight	Moderate: depth to rock.	Slight.
MrB: Morley	Moderate: percs slowly.	Slight	Moderate: percs slowly, slope.	Slight.
MsB: Morley	Moderate: percs slowly.	Slight	Moderate: percs slowly, slope.	Slight.
MsC: Morley	Moderate: percs slowly, slope.	Moderate: slope.	Severe: slope.	Slight.
MsD: Morley	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
MtC3: Morley	Moderate: percs slowly, slope.	Moderate: too clayey, slope.	Severe: slope.	Moderate: too clayey.
MtD3: Morley	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too clayey, slope.
OcA: Ockley	Slight	Slight	Slight	Slight.
OcB: Ockley	Slight	Slight	Moderate: slope.	Slight.
Or*. Orthents				
OsB*:				
Ormas	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.
Oshtemo	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones.	Moderate: too sandy.
OtA: Oshtemo	Slight	Slight	Moderate: small stones.	Slight.
Pm: Palms	Severe: wetness, floods, excess humus.	Severe: wetness, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, excess humus.
Pt: Patton	Severe: floods, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Pw: Pewamo	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.

See footnote at end of table.

TABLE 14.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Pz*. Pits				
Re: Rensselaer	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.
Ro: Ross	Slight	Slight	Slight	Slight.
Se: Sebewa	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.
Sh: Shoals	Severe: floods, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
Sn: Sleeth	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
So: Sloan	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.
St: Stonelick	Severe: floods.	Slight	Moderate: floods.	Slight.
Tr: Treaty	Severe: floods, wetness.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.
Wh: Washtenaw	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.
WsB: Wawasee	Slight	Slight	Moderate: slope.	Slight.
WsC, WsC3: Wawasee	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
WsD3: Wawasee	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--WILDLIFE HABITAT POTENTIALS

[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
Au-----------------Aubbeenaubbee	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Ba, Bc-------------Blount	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Br-----------------Brookston	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
ChB----------------Chelsea	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.
Cr-----------------Crosier	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Fn-----------------Fincastle	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
FsA, FsB, FzC3-----Fox	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Ge-----------------Gessie	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Gr-----------------Gilford	Fair	Poor	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
HeG----------------Hennepin	Very poor.	Poor	Good	Good	Fair	Very poor.	Very poor.	Poor	Good	Very poor.
Hx-----------------Houghton	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
MaA----------------Martinsville	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
MeB----------------Metea	Poor	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
MhB----------------Miami	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
MhC3---------------Miami	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
MhD3---------------Miami	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Mk-----------------Milford	Good	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
Mm-----------------Millsdale	Very poor.	Poor	Poor	Poor	Poor	Good	Fair	Poor	Poor	Fair.
Mp-----------------Milton	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
MrB, MsB-----------Morley	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
MsC----------------Morley	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.

TABLE 15.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
MsD: Morley	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
MtC3: Morley	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
MtD3: Morley	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
OcA, OcB: Ockley	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Or*. Orthents										
OsB*:										
Ormas	Poor	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
Oshtemo	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
OtA: Oshtemo	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Pm: Palms	Good	Poor	Poor	Poor	Poor	Good	Good	Fair	Poor	Poor.
Pt: Patton	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
Pw: Pewamo	Good	Fair	Fair	Fair	Fair	---	Good	Fair	Fair	Good.
Pz*. Pits										
Re: Rensselaer	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Ro: Ross	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Se: Sebewa	Good	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
Sh: Shoals	Poor	Fair	Fair	Good	Good	Fair	Fair	Fair	Good	Fair.
Sn: Sleeth	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
So: Sloan	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
St: Stonelick	Fair	Good	Good	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.
Tr: Treaty	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Wh: Washtenaw	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
WsB: Wawasee	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.

See footnote at end of table.

TABLE 15.--WILDLIFE HABITAT POTENTIALS--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	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
WsC, WsC3, WsD3---- Wawasee	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--ENGINEERING PROPERTIES AND CLASSIFICATIONS

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Au----------------- Aubbeenaubbee	0-22	Sandy loam------	SM, SM-SC	A-2-4, A-4	0	100	75-95	60-80	30-40	<25	NP-6
	22-48	Sandy clay loam, clay loam.	CL, SC	A-6, A-2-6	0	95-100	90-100	80-90	30-55	25-35	11-16
	48-60	Loam, silt loam, clay loam.	CL, CL-ML, ML	A-4, A-6	0-3	85-90	80-90	70-85	50-60	20-35	2-14
Ba----------------- Blount	0-9	Loam------------	ML, CL	A-6, A-4	0-5	95-100	95-100	90-100	80-95	25-40	3-15
	9-45	Silty clay loam, silty clay, clay loam.	CH, CL	A-7, A-6	0-5	95-100	90-100	90-100	80-95	35-60	15-35
	45-60	Silty clay loam, clay loam.	CL	A-6	0-10	90-100	90-100	80-100	70-90	25-40	10-25
Bc----------------- Blount	0-9	Silt loam-------	ML, CL	A-6, A-4	0-5	95-100	95-100	90-100	80-95	25-40	3-15
	9-45	Silty clay loam, silty clay, clay loam.	CH, CL	A-7, A-6	0-5	95-100	90-100	90-100	80-95	35-60	15-35
	45-60	Silty clay loam, clay loam.	CL	A-6	0-10	90-100	90-100	80-100	70-90	25-40	10-25
Br----------------- Brookston	0-12	Loam------------	CL	A-4, A-6	0	98-100	98-100	85-100	60-90	22-40	8-18
	12-49	Clay loam, silty clay loam.	CL, CH	A-6, A-7	0	98-100	85-100	75-95	60-85	36-52	18-30
	49-60	Loam, sandy loam, clay loam.	CL	A-4, A-6	0-3	90-100	85-95	78-90	55-70	22-30	7-15
ChB---------------- Chelsea	0-8	Fine sand-------	SM, SP-SM	A-2-4	0	100	100	65-80	10-35	---	NP
	8-60	Fine sand, sand, loamy fine sand.	SP, SM, SP-SM	A-3, A-2-4	0	100	100	65-80	3-15	---	NP
Cr----------------- Crosier	0-12	Loam------------	CL	A-4, A-6	0	100	95-100	85-95	60-80	22-33	8-15
	12-33	Clay loam-------	CL	A-6, A-7	0	90-95	85-95	75-90	60-70	33-47	15-26
	33-60	Loam------------	CL, ML	A-4, A-6	0-3	85-90	80-88	70-85	50-60	25-35	2-12
Fn----------------- Fincastle	0-11	Silt loam-------	CL, ML	A-4, A-6	0	100	95-100	90-100	75-93	27-36	4-12
	11-26	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	95-100	85-95	38-54	20-32
	26-46	Clay loam, loam	CH, CL	A-7	0	95-100	90-98	85-95	75-85	45-58	30-38
	46-60	Loam------------	CL, ML, CL-ML	A-4	0-3	88-96	82-90	70-86	50-66	20-30	3-10
FsA, FsB----------- Fox	0-9	Silt loam-------	ML, CL, CL-ML	A-4	0	95-100	85-100	75-95	55-90	20-30	3-10
	9-24	Silty clay loam, silt loam, clay loam.	CL	A-6, A-7	0	85-100	75-100	70-95	55-90	25-50	10-25
	24-39	Clay loam, loam, gravelly clay loam.	CL, SC	A-2, A-6, A-7	0-5	85-100	75-95	50-95	20-65	25-45	10-25
	39-60	Sand and gravel	SP, SM, GP, GM	A-1, A-2, A-3	0-10	40-100	35-100	15-95	2-20	---	NP
FzC3--------------- Fox	0-6	Clay loam-------	CL	A-6	0	90-100	75-100	75-95	60-80	20-40	10-20
	6-30	Clay loam, loam, gravelly clay loam.	CL, SC	A-2, A-6, A-7	0-5	85-100	75-95	50-95	20-65	25-45	10-25
	30-60	Sand and gravel	SP, SM, GP, GM	A-1, A-2, A-3	0-10	40-100	35-100	15-95	2-20	---	NP
Ge----------------- Gessie	0-10	Silt loam-------	CL-ML, ML, CL	A-6, A-4	0	100	95-100	80-100	70-85	26-40	5-15
	10-60	Silt loam, loam	CL-ML, ML, CL	A-6, A-4	0	100	95-100	80-100	70-85	26-40	5-15

TABLE 16.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Gr------------------ Gilford	0-20	Sandy loam------	SC, SM-SC	A-4, A-2-4	0	95-100	90-100	60-70	30-40	20-30	4-10
	20-39	Sandy loam, fine sandy loam.	SM, SC, SM-SC	A-2-4	0	90-100	90-100	55-70	20-35	15-30	NP-8
	39-66	Loamy sand, sand	SM, SP, SP-SM	A-3, A-1-b, A-2-4	0	90-100	85-100	18-60	3-20	---	NP
HeG----------------- Hennepin	0-12	Silt loam, loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	70-100	60-95	25-40	5-20
	12-60	Loam, sandy loam, clay loam.	SC, SM-SC, CL, CL-ML	A-4, A-6, A-7	0-5	85-100	80-100	65-100	35-95	20-50	5-25
Hx------------------ Houghton	0-60	Sapric material	Pt	A-8	0	---	---	---	---	---	---
MaA----------------- Martinsville	0-9	Sandy loam------	SM, SC, SM-SC	A-4	0	100	90-100	65-80	35-45	<25	2-10
	9-37	Clay loam, silty clay loam, loam.	CL, SC	A-4, A-6	0	100	90-100	65-90	40-90	20-35	8-20
	37-41	Sandy loam, sandy clay loam, loam.	SM, ML	A-2-4, A-4	0	100	90-100	60-80	30-60	30-40	2-8
	41-60	Stratified sand to silty clay loam.	CL, SC, CL-ML, SM-SC	A-4	0	95-100	85-100	80-95	40-60	<25	4-9
MeB----------------- Metea	0-28	Loamy fine sand	SM	A-2-4	0	100	100	50-80	15-35	---	NP
	28-44	Clay loam, sandy clay loam, silty clay loam.	CL, SC	A-6, A-7	0	90-100	90-95	75-95	40-75	25-50	12-30
	44-60	Loam, silty clay loam, clay loam.	CL, ML	A-4, A-6	0-3	85-95	80-90	75-90	50-75	25-40	5-18
MhB----------------- Miami	0-14	Silt loam-------	CL, CL-ML	A-4, A-6	0	100	95-100	80-100	50-90	22-34	6-15
	14-34	Clay loam, silty clay loam.	CL	A-6, A-7	0	92-99	89-97	78-95	64-95	35-50	17-31
	34-60	Loam, clay loam, sandy loam.	CL, CL-ML, ML	A-4, A-6	0-3	88-94	83-89	74-87	50-64	17-30	2-14
MhC3, MhD3---------- Miami	0-6	Clay loam-------	CL	A-6, A-7	0	100	90-100	75-95	65-95	30-45	15-25
	6-26	Clay loam, silty clay loam, sandy clay loam.	CL	A-6, A-7	0	92-99	89-97	78-95	64-95	35-50	17-31
	26-60	Loam, clay loam.	CL, CL-ML, ML	A-4, A-6	0-3	88-94	83-89	74-87	50-64	17-30	2-14
Mk------------------ Milford	0-15	Silty clay------	CL, CH	A-7	0	100	95-100	90-100	80-95	40-60	20-35
	15-60	Silty clay, silty clay loam, clay loam.	CH, CL	A-7	0	100	95-100	90-100	75-100	40-60	20-40
Mm------------------ Millsdale	0-12	Silty clay loam	CL	A-6, A-7	0	95-100	90-100	85-100	80-90	32-50	12-25
	12-31	Clay, silty clay, clay loam.	CH, CL	A-7, A-6	0-5	90-100	90-100	85-100	80-95	35-60	20-35
	31-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---

TABLE 16.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--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	
Mp----------------- Milton	0-8	Silt loam-------	ML, CL	A-4, A-6	0	95-100	90-100	85-100	70-95	26-36	4-12
	8-32	Silty clay loam, gravelly clay loam.	CL	A-6, A-7	0	95-100	80-100	75-100	70-95	32-48	12-28
	32	Weathered bedrock.	---	---	---	---	---	---	---	---	---
MrB---------------- Morley	0-14	Sandy loam------	SC, SM-SC	A-4, A-2	0-5	95-100	90-100	55-75	25-40	15-30	3-10
	14-42	Silty clay, clay loam, clay.	CL, CH	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-55	15-30
	42-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-45	10-25
MsB, MsC, MsD------ Morley	0-7	Silt loam-------	CL, CL-ML	A-6, A-4	0-5	95-100	95-100	90-100	85-95	25-40	5-15
	7-35	Silty clay, clay loam, clay.	CL, CH	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-55	15-30
	35-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-45	10-25
MtC3, MtD3--------- Morley	0-7	Silty clay loam	CL	A-6	0-5	95-100	90-100	85-95	80-90	25-40	10-20
	7-31	Silty clay, clay loam, clay.	CL, CH	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-55	15-30
	31-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-45	10-25
OcA, OcB----------- Ockley	0-12	Silt loam-------	CL, ML, CL-ML	A-4, A-6	0	100	95-100	80-100	60-90	22-33	3-12
	12-40	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	75-100	65-90	50-90	35-50	15-30
	40-48	Gravelly clay loam, gravelly sandy clay loam.	CL, SC, GC	A-6, A-7	0-2	70-85	45-75	40-70	35-55	30-50	15-30
	48-60	Stratified sand to gravelly sand.	SP, SP-SM, GP, GP-GM	A-1	1-5	30-70	20-55	5-20	2-10	---	NP
Or*. Orthents											
OsB*:											
Ormas-------------	0-24	Loamy sand------	SM	A-2-4	0	98-100	95-100	50-75	15-30	---	NP
	24-38	Sand------------	SW-SM, SM, SP-SM	A-2-4	0	95-100	90-100	45-70	10-20	---	NP
	38-59	Gravelly sandy clay loam, gravelly sandy loam, 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
	59-64	Gravelly sand---	SP, SP-SM	A-3, A-1-b, A-2-4	0	60-80	55-80	30-55	3-12	---	NP
Oshtemo-----------	0-13	Loamy sand------	SM	A-2, A-1	0	75-100	60-95	40-70	15-30	---	NP
	13-48	Sandy loam, loam.	SM, SC, SM-SC	A-2, A-4, A-6	0	75-100	60-95	60-85	25-45	12-30	2-16
	48-60	Stratified coarse 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

See footnote at end of table.

TABLE 16.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--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	
OtA----------------- Oshtemo	0-11	Sandy loam------	SM, SM-SC	A-2, A-4	0	75-100	60-95	60-70	25-40	15-25	2-7
	11-40	Sandy loam, sandy clay loam.	SM, SC, SM-SC	A-2, A-4, A-6	0	75-100	60-95	60-85	25-45	12-30	2-16
	40-51	Loamy fine sand-	SM, SP-SM	A-2	0	85-95	60-95	55-70	10-15	---	NP
	51-60	Stratified coarse 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
Pm----------------- Palms	0-25	Sapric material	Pt	---	---	---	---	---	---	---	---
	25-60	Silt loam, silty clay loam, fine sandy loam.	CL-ML, CL	A-4, A-6	0	85-100	80-100	70-95	50-90	25-40	5-20
Pt----------------- Patton	0-10	Silty clay loam	CL	A-6	0	100	100	95-100	75-95	30-40	10-20
	10-38	Silty clay loam	CL, CH, ML, MH	A-7	0	100	100	95-100	80-100	40-55	15-25
	38-70	Silt loam, silty clay loam.	CL	A-6	0	100	100	95-100	75-95	25-40	10-20
Pw----------------- Pewamo	0-13	Silty clay loam	CL	A-6	0-5	95-100	90-100	90-100	70-90	25-40	10-20
	13-29	Clay loam, clay, silty clay.	CL, CH	A-6, A-7	0-5	95-100	90-100	90-100	75-95	35-55	15-30
	29-60	Clay loam, silty clay loam.	CL	A-6, A-7	0-5	95-100	90-100	90-100	70-90	30-45	14-25
Pz*. Pits											
Re----------------- Rensselaer	0-14	Loam------------	CL, ML	A-4, A-6	0	100	100	90-100	70-90	27-36	4-12
	14-41	Clay loam, silty clay loam.	CL	A-6, A-7	0	95-100	90-100	80-100	60-80	33-47	15-26
	41-60	Stratified fine sand to clay loam.	CL, SC, CL-ML, SM-SC	A-4, A-2	0	95-100	90-100	60-95	20-70	<30	4-9
Ro----------------- Ross	0-12	Silt loam-------	ML, CL-ML, CL	A-4, A-6	0	90-100	90-100	80-100	65-95	20-35	NP-12
	12-37	Loam, silt loam	ML, CL	A-6, A-4, A-7	0	90-100	85-100	70-100	55-95	30-45	3-18
	37-60	Stratified gravel to silt loam.	CL, ML, SM, GM	A-6, A-1, A-2	0-5	50-100	40-100	30-100	10-80	<30	NP-12
Se----------------- Sebewa	0-12	Loam------------	CL, CL-ML	A-4, A-6	0	95-100	80-100	75-95	50-90	22-35	6-12
	12-33	Clay loam, loam, gravelly clay loam.	SC, CL	A-4, A-6	0	95-100	65-95	55-85	40-75	25-40	8-20
	33-60	Sand and gravel	SP, SP-SM, GP, GP-GM	A-1	0-5	40-75	35-70	20-40	0-10	---	NP
Sh----------------- Shoals	0-8	Silt loam-------	CL, CL-ML	A-4, A-6	0	100	100	90-100	65-90	22-36	6-15
	8-60	Silt loam, loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	100	90-100	75-85	25-40	4-15

See footnote at end of table.

TABLE 16.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--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	
Sn----------------- Sleeth	0-14	Loam------------	CL, ML, CL-ML	A-4, A-6	0	100	90-100	75-95	50-85	20-35	3-15
	14-20	Clay loam, silty clay loam, sandy clay loam.	CL, SC	A-6	0	85-95	85-95	80-90	45-75	30-40	15-25
	20-45	Gravelly clay loam, gravelly sandy clay loam, gravelly loam.	CL	A-6	0-3	65-95	60-85	55-70	50-70	30-40	15-25
	45-60	Stratified sand to gravelly sand.	SP, GP, SP-SM, GP-GM	A-1	1-5	30-70	22-55	7-20	2-10	---	NP
So----------------- Sloan	0-18	Silty clay loam	CL	A-6, A-7	0	100	95-100	85-100	70-95	35-45	12-20
	18-60	Loam, clay loam, silt loam.	CL, ML	A-6, A-7, A-4	0	100	90-100	85-100	75-95	30-45	8-18
St----------------- Stonelick	0-10	Sandy loam------	SM, SC, ML, CL	A-4, A-2	0	85-100	70-100	50-70	30-60	20-32	NP-10
	10-60	Stratified sandy to silt loam.	SM, SP-SM	A-2, A-4, A-3, A-1-b	0	85-100	70-95	40-60	5-40	---	NP
Tr----------------- Treaty	0-12	Silt loam	CL	A-6, A-7	0	100	100	95-100	85-95	30-45	12-25
	12-38	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-95	30-50	15-30
	38-45	Clay loam, silty clay loam, loam.	CL	A-6, A-7	0	95-100	85-100	75-95	55-85	28-48	12-25
	45-60	Loam------------	CL-ML, CL	A-4, A-6	0	90-100	85-95	75-90	55-75	20-30	6-15
Wh----------------- Washtenaw	0-8	Silt loam-------	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	70-90	27-36	4-12
	8-23	Silt loam, loam	CL, ML, CL-ML	A-6, A-4	0	100	100	90-100	70-90	27-36	4-12
	23-70	Silty clay loam, clay loam.	CL	A-6, A-7	0	95-100	95-100	90-100	75-95	36-50	15-28
	70-75	Loam------------	CL	A-4, A-6	0-3	90-100	85-95	80-95	60-75	22-33	8-15
WsB, WsC----------- Wawasee	0-15	Sandy loam------	SM, SM-SC	A-2-4, A-4	0	90-95	85-95	80-95	30-50	<25	NP-6
	15-36	Loam, sandy clay loam.	SC, CL	A-4, A-6	0	90-95	85-95	80-95	45-70	25-35	7-15
	36-60	Loam, sandy loam	SM-SC, SC, CL-ML, CL	A-4, A-6	0	85-95	80-95	80-95	45-65	20-30	4-12
WsC3, WsD3--------- Wawasee	0-6	Loam------------	CL, CL-ML	A-4, A-6	0	90-95	85-95	80-95	50-70	20-30	4-12
	6-26	Loam, sandy clay loam.	SC, CL	A-4, A-6	0	90-95	85-95	80-95	45-70	25-35	7-15
	26-60	Loam, sandy loam	SM-SC, SC, CL-ML, CL	A-4, A-6	0	85-95	80-95	80-95	45-65	20-30	4-12

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" 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	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group
						K	T	
	In	In/hr	In/in	pH				
Au------------- Aubbeenaubbee	0-22	2.0-6.0	0.16-0.18	6.1-7.3	Low-----------	0.24	5	3
	22-48	0.6-2.0	0.16-0.18	5.6-7.3	Moderate------	0.32		
	48-60	0.6-2.0	0.10-0.19	7.4-8.4	Low-----------	0.32		
Ba, Bc----------- Blount	0-9	0.6-2.0	0.20-0.24	5.1-6.5	Low-----------	0.43	3	6
	9-45	0.06-0.6	0.06-0.10	4.5-6.5	Moderate------	0.43		
	45-60	0.06-0.6	0.07-0.10	7.4-8.4	Moderate------	0.43		
Br--------------- Brookston	0-12	0.6-2.0	0.21-0.24	6.1-7.3	Moderate------	0.28	5	6
	12-49	0.6-2.0	0.15-0.19	6.1-7.3	Moderate------	0.28		
	49-60	0.6-2.0	0.05-0.19	7.4-8.4	Moderate------	0.28		
ChB-------------- Chelsea	0-8	6.0-20	0.10-0.15	5.6-7.3	Low-----------	0.17	5	2
	8-60	6.0-20	0.06-0.08	5.1-5.5	Low-----------	0.17		
Cr--------------- Crosier	0-12	0.6-2.0	0.20-0.22	6.1-7.3	Low-----------	0.32	5	5
	12-33	0.2-0.6	0.15-0.19	5.6-7.3	Moderate------	0.32		
	33-60	0.2-0.6	0.10-0.19	7.9-8.4	Low-----------	0.32		
Fn--------------- Fincastle	0-11	0.6-2.0	0.22-0.24	6.1-7.3	Low-----------	0.37	5	5
	11-26	0.2-0.6	0.18-0.20	5.1-6.0	Moderate------	0.37		
	26-46	0.2-0.6	0.15-0.19	5.1-7.3	Moderate------	0.37		
	46-60	0.2-0.6	0.05-0.19	7.4-8.4	Low-----------	0.37		
FsA, FsB--------- Fox	0-9	0.6-2.0	0.20-0.24	5.1-7.3	Low-----------	0.32	4	5
	9-24	0.6-2.0	0.15-0.22	5.1-7.3	Moderate------	0.32		
	24-39	0.6-2.0	0.15-0.19	5.6-7.8	Moderate------	0.32		
	39-60	>6.0	0.02-0.04	7.9-8.4	Low-----------	0.10		
FzC3------------- Fox	0-6	0.6-2.0	0.17-0.19	5.1-7.3	Moderate------	0.32	3	6
	6-30	0.6-2.0	0.15-0.19	5.6-7.8	Moderate------	0.32		
	30-60	>6.0	0.02-0.04	7.9-8.4	Low-----------	0.10		
Ge--------------- Gessie	0-10	0.6-2.0	0.20-0.24	7.4-8.4	Low-----------	0.37	5	5
	10-60	0.6-2.0	0.17-0.22	7.4-8.4	Low-----------	0.37		
Gr--------------- Gilford	0-20	2.0-6.0	0.13-0.15	6.1-7.3	Low-----------	0.20	5	3
	20-39	2.0-6.0	0.12-0.14	6.1-7.3	Low-----------	0.20		
	39-66	6.0-20	0.05-0.08	6.6-8.4	Low-----------	0.15		
HeG-------------- Hennepin	0-12	0.6-2.0	0.18-0.24	6.1-7.8	Low-----------	0.32	4	5
	12-60	0.2-0.6	0.07-0.11	6.1-8.4	Low-----------	0.32		
Hx--------------- Houghton	0-60	2.0-6.0	0.35-0.45	5.6-7.8	--------------	---	---	3
MaA-------------- Martinsville	0-9	0.6-2.0	0.16-0.18	5.6-7.3	Low-----------	0.24	5	3
	9-37	0.6-2.0	0.17-0.20	5.1-6.0	Moderate------	0.37		
	37-41	0.6-2.0	0.12-0.14	5.6-6.5	Low-----------	0.24		
	41-60	0.6-2.0	0.19-0.21	7.4-8.4	Low-----------	0.24		
MeB-------------- Metea	0-28	>20	0.10-0.12	5.6-7.3	Low-----------	0.17	5	2
	28-44	0.6-2.0	0.15-0.19	5.6-7.3	Moderate------	0.32		
	44-60	0.2-0.6	0.05-0.19	7.4-8.4	Low-----------	0.32		
MhB-------------- Miami	0-14	0.6-2.0	0.20-0.24	5.6-7.3	Low-----------	0.37	5	5
	14-34	0.6-2.0	0.15-0.20	5.6-6.0	Moderate------	0.37		
	34-60	0.2-0.6	0.05-0.19	6.6-8.4	Low-----------	0.37		
MhC3, MhD3------- Miami	0-6	0.6-2.0	0.18-0.20	5.6-7.3	Moderate------	0.37	4	6
	6-26	0.6-2.0	0.15-0.20	5.6-6.0	Moderate------	0.37		
	26-60	0.2-0.6	0.05-0.19	6.6-8.4	Low-----------	0.37		
Mk--------------- Milford	0-15	0.6-2.0	0.12-0.23	6.1-7.3	High----------	0.28	5	4
	15-60	0.2-0.6	0.11-0.20	6.6-7.8	High----------	0.28		

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH				
Mm------------- Millsdale	0-12	0.6-2.0	0.15-0.18	6.1-7.3	Moderate------	0.32	4	6
	12-31	0.6-2.0	0.12-0.16	6.1-7.8	High----------	0.32		
	31-60	---	---	---	--------------	---		
Mp------------- Milton	0-8	0.6-2.0	0.17-0.20	5.6-7.3	Low-----------	0.37	4	6
	8-32	0.6-2.0	0.16-0.19	4.5-7.8	Moderate------	0.37		
	32	---	---	---	--------------	---		
MrB------------ Morley	0-14	0.6-2.0	0.20-0.24	5.1-6.5	Low-----------	0.43	3	6
	14-42	0.06-0.6	0.11-0.13	5.6-6.5	Moderate------	0.43		
	42-60	0.06-0.6	0.09-0.20	6.6-8.4	Moderate------	0.43		
MsB, MsC, MsD---- Morley	0-7	0.6-2.0	0.20-0.24	5.1-6.5	Low-----------	0.43	3	6
	7-35	0.06-0.6	0.11-0.13	5.6-6.5	Moderate------	0.43		
	35-60	0.06-0.6	0.09-0.20	6.6-8.4	Moderate------	0.43		
MtC3, MtD3------- Morley	0-7	0.2-0.6	0.18-0.22	5.1-6.5	Moderate------	0.43	2	7
	7-31	0.06-0.2	0.11-0.13	5.6-6.5	Moderate------	0.43		
	31-60	0.2-0.6	0.09-0.20	6.6-8.4	Moderate------	0.43		
OcA, OcB--------- Ockley	0-12	0.6-2.0	0.20-0.24	5.6-6.5	Low-----------	0.37	5	5
	12-40	0.6-2.0	0.15-0.20	4.5-6.0	Moderate------	0.37		
	40-48	0.6-2.0	0.12-0.14	5.6-6.5	Moderate------	0.24		
	48-60	>20	0.02-0.04	7.4-8.4	Low-----------	0.10		
Or*. Orthents								
OsB*:								
Ormas-----------	0-24	2.0-6.0	0.10-0.12	5.6-7.3	Low-----------	0.17	5	2
	24-38	2.0-6.0	0.07-0.09	5.6-6.5	Low-----------	0.17		
	38-59	2.0-6.0	0.11-0.14	5.6-7.8	Low-----------	0.32		
	59-64	6.0-20	0.03-0.05	7.4-8.4	Low-----------	0.15		
Oshtemo---------	0-13	6.0-20	0.10-0.12	5.1-6.5	Low-----------	0.24	5	2
	13-48	2.0-6.0	0.12-0.19	5.1-6.5	Low-----------	0.24		
	48-60	>20	0.02-0.04	7.4-8.4	Low-----------	0.10		
OtA------------ Oshtemo	0-11	2.0-6.0	0.10-0.15	5.1-6.5	Low-----------	0.24	5	3
	11-40	2.0-6.0	0.12-0.19	5.1-6.5	Low-----------	0.24		
	40-51	6.0-20	0.06-0.08	5.1-7.3	Low-----------	0.17		
	51-60	>20	0.02-0.04	7.4-8.4	Low-----------	0.10		
Pm------------- Palms	0-25	0.2-6.0	0.35-0.45	5.1-8.4	--------------	---	---	3
	25-60	0.6-2.0	0.14-0.22	6.1-8.4	Low-----------	---		
Pt------------- Patton	0-10	0.6-2.0	0.21-0.23	6.6-7.3	Moderate------	0.28	5	7
	10-38	0.6-2.0	0.18-0.20	6.1-7.8	Moderate------	0.28		
	38-70	0.6-2.0	0.18-0.22	7.4-7.8	Moderate------	0.28		
Pw------------- Pewamo	0-13	0.6-2.0	0.17-0.22	6.1-7.3	Moderate------	0.24	5	6
	13-29	0.2-0.6	0.12-0.20	6.1-7.8	Moderate------	0.24		
	29-60	0.2-0.6	0.14-0.18	7.4-8.4	Moderate------	0.24		
Pz*. Pits								
Re------------- Rensselaer	0-14	0.2-0.6	0.20-0.24	6.6-7.3	Low-----------	0.28	5	5
	14-41	0.6-2.0	0.15-0.19	6.1-7.3	Moderate------	0.28		
	41-60	0.6-2.0	0.19-0.21	7.9-8.4	Low-----------	0.28		
Ro------------- Ross	0-12	0.6-2.0	0.19-0.24	6.1-7.8	Low-----------	0.24	5	5
	12-37	0.6-2.0	0.16-0.22	6.1-7.8	Low-----------	0.24		
	37-60	0.6-2.0	0.05-0.18	6.1-7.8	Low-----------	0.24		

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permea- bility	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group
						K	T	
	In	In/hr	In/in	pH				
Se: Sebewa	0-12	0.6-2.0	0.18-0.22	6.1-7.8	Low	0.24	5	5
	12-33	0.6-2.0	0.15-0.19	6.1-7.8	Low	0.24		
	33-60	6.0-20	0.02-0.04	7.4-8.4	Low	0.10		
Sh: Shoals	0-8	0.6-2.0	0.22-0.24	6.1-7.8	Low	0.37	5	5
	8-60	0.6-2.0	0.17-0.22	6.1-7.8	Low	0.37		
Sn: Sleeth	0-14	0.6-2.0	0.20-0.24	6.6-7.3	Low	0.32	5	5
	14-20	0.6-2.0	0.15-0.19	5.6-6.5	Moderate	0.32		
	20-45	0.6-2.0	0.14-0.16	6.6-8.4	Moderate	0.32		
	45-60	>20	0.02-0.04	7.9-8.4	Low	0.10		
So: Sloan	0-18	0.6-2.0	0.18-0.22	6.1-7.8	Moderate	0.37	5	7
	18-60	0.6-2.0	0.15-0.19	6.1-8.4	Moderate	0.37		
St: Stonelick	0-10	2.0-6.0	0.09-0.13	7.4-8.4	Low	0.24	5	3
	10-60	2.0-6.0	0.05-0.09	7.4-8.4	Low	0.24		
Tr: Treaty	0-12	0.6-2.0	0.22-0.24	6.1-7.3	Low	0.32	5	7
	12-38	0.6-2.0	0.18-0.20	6.1-7.3	Moderate	0.43		
	38-45	0.6-2.0	0.15-0.19	6.6-7.8	Moderate	0.43		
	45-60	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.43		
Wh: Washtenaw	0-8	0.6-2.0	0.22-0.24	6.1-7.3	Low	0.37	5	5
	8-23	0.6-2.0	0.20-0.22	6.1-7.3	Low	0.37		
	23-70	0.2-0.6	0.15-0.20	6.1-7.3	Moderate	0.37		
	70-75	0.2-0.6	0.05-0.19	7.4-8.4	Moderate	0.37		
WsB, WsC: Wawasee	0-15	0.6-2.0	0.13-0.15	6.1-7.3	Low	0.28	5	3
	15-36	0.6-2.0	0.12-0.18	6.1-7.3	Low	0.28		
	36-60	0.6-2.0	0.11-0.18	6.6-8.4	Low	0.28		
WsC3, WsD3: Wawasee	0-6	0.6-2.0	0.15-0.18	6.1-7.3	Low	0.28	4	5
	6-26	0.6-2.0	0.12-0.18	6.1-7.3	Low	0.28		
	26-60	0.6-2.0	0.11-0.18	6.6-8.4	Low	0.28		

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--SOIL AND WATER FEATURES

[The definitions of "flooding" and "water table" in the Glossary explain terms such as "rare," "brief," "apparent," and "perched." The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Au: Aubbeenaubbee	B	None	---	---	1.0-3.0	Apparent	Jan-Apr	>60	---	High	High	Moderate.
Ba, Bc: Blount	C	None	---	---	1.0-3.0	Perched	Jan-May	>60	---	High	High	High.
Br: Brookston	B/D	Frequent	Brief	Dec-May	0-1.0	Apparent	Dec-May	>60	---	High	High	Low.
ChB: Chelsea	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
Cr: Crosier	C	None	---	---	1.0-3.0	Apparent	Jan-Apr	>60	---	High	High	Low.
Fn: Fincastle	C	None	---	---	1.0-3.0	Apparent	Jan-Apr	>60	---	High	High	Moderate.
FsA, FsB, FzC3: Fox	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Moderate.
Ge: Gessie	B	Rare	Brief	Oct-May	>6.0	---	---	>60	---	Moderate	Low	Low.
Gr: Gilford	B/D	Frequent	Brief	Dec-May	0-1.0	Apparent	Dec-May	>60	---	High	High	Moderate.
HeG: Hennepin	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
Hx: Houghton	A/D	Frequent	Long	Nov-May	0-1.0	Apparent	Sep-Jun	>60	---	High	High	Low.
MaA: Martinsville	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
MeB: Metea	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
MhB, MhC3, MhD3: Miami	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
Mk: Milford	B/D	Occasional	Brief	Apr-Jun	0-2.0	Apparent	Mar-Jun	>60	---	High	High	Low.
Mm: Millsdale	B/D	None	---	---	0-0.5	Perched	Jan-Apr	20-40	Hard	High	High	Low.
Mp: Milton	C	None	---	---	>6.0	---	---	20-40	Hard	Moderate	High	Moderate.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
MrB, MsB, MsC, MsD, MtC3, MtD3-- Morley	C	None--------	---	---	3.0-6.0	Perched	Mar-May	>60	---	Moderate	High-----	Moderate.
OcA, OcB---------- Ockley	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
Or*. Orthents												
OsB*:												
Ormas------------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Moderate.
Oshtemo----------	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	High.
OtA--------------- Oshtemo	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	High.
Pm---------------- Palms	A/D	Frequent----	Long------	Nov-May	0-1.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
Pt---------------- Patton	B/D	Rare--------	---	---	0-2.0	Apparent	Mar-Jun	>60	---	High-----	High-----	Low.
Pw---------------- Pewamo	C/D	Frequent----	Brief-----	Mar-Apr	0-1.0	Apparent	Dec-May	>60	---	High-----	High-----	Low.
Pz*. Pits												
Re---------------- Rensselaer	B/D	Frequent----	Brief-----	Dec-May	0-1.0	Apparent	Dec-May	>60	---	High-----	High-----	Low.
Ro---------------- Ross	B	None--------	---	---	4.0-6.0	Apparent	Feb-Apr	>60	---	Moderate	Low------	Low.
Se---------------- Sebewa	B/D	Frequent----	Brief-----	Mar-May	0-1.0	Apparent	Sep-May	>60	---	High-----	High-----	Low.
Sh---------------- Shoals	C	Rare--------	Brief-----	Oct-Jun	1.0-3.0	Apparent	Jan-Apr	>60	---	High-----	High-----	Low.
Sn---------------- Sleeth	C	None--------	---	---	1.0-3.0	Apparent	Jan-Apr	>60	---	High-----	High-----	Low.
So---------------- Sloan	B/D	Frequent----	Very brief	Nov-Jun	0-0.5	Apparent	Nov-Jun	>60	---	High-----	High-----	Low.
St---------------- Stonelick	B	Occasional	Very brief	Nov-Jun	>6.0	---	---	>60	---	Moderate	Low------	Low.
Tr---------------- Treaty	B/D	Frequent----	Brief-----	Dec-May	0-1.0	Apparent	Dec-May	>60	---	High-----	High-----	Low.

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Wh----------------- Washtenaw	C/D	Frequent----	Brief-----	Dec-May	0-1.0	Apparent	Dec-May	>60	---	High-----	High-----	Low.
WsB, WsC, WsC3, WsD3-------------- Wawasee	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.

* 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 this soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
Aubbeenaubbee	Fine-loamy, mixed, mesic Aeric Ochraqualfs
Blount	Fine, illitic, mesic Aeric Ochraqualfs
Brookston	Fine-loamy, mixed, mesic Typic Argiaquolls
Chelsea	Mixed, mesic Alfic Udipsamments
Crosier	Fine-loamy, mixed, mesic Aeric Ochraqualfs
Fincastle	Fine-silty, mixed, mesic Aeric Ochraqualfs
Fox	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludalfs
Gessie	Fine-loamy, mixed (calcareous), mesic Typic Udifluvents
Gilford	Coarse-loamy, mixed, mesic Typic Haplaquolls
Hennepin	Fine-loamy, mixed, mesic Typic Eutrochrepts
Houghton	Euic, mesic Typic Medisaprists
Martinsville	Fine-loamy, mixed, mesic Typic Hapludalfs
Metea	Loamy, mixed, mesic Arenic Hapludalfs
Miami	Fine-loamy, mixed, mesic Typic Hapludalfs
Milford	Fine, mixed, mesic Typic Haplaquolls
Millsdale	Fine, mixed, mesic Typic Argiaquolls
Milton	Fine, mixed, mesic Typic Hapludalfs
Morley	Fine, illitic, mesic Typic Hapludalfs
Ockley	Fine-loamy, mixed, mesic Typic Hapludalfs
Ormas	Loamy, mixed, mesic Arenic Hapludalfs
Oshtemo	Coarse-loamy, mixed, mesic Typic Hapludalfs
Palms	Loamy, mixed, euic, mesic Terric Medisaprists
Patton	Fine-silty, mixed, mesic Typic Haplaquolls
Pewamo	Fine, mixed, mesic Typic Argiaquolls
Rensselaer	Fine-loamy, mixed, mesic Typic Argiaquolls
*Ross	Fine-loamy, mixed, mesic Cumulic Hapludolls
Sebewa	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Argiaquolls
Shoals	Fine-loamy, mixed, nonacid, mesic Aeric Fluvaquents
Sleeth	Fine-loamy, mixed, mesic Aeric Ochraqualfs
Sloan	Fine-loamy, mixed, mesic Fluvaquentic Haplaquolls
Stonelick	Coarse-loamy, mixed (calcareous), mesic Typic Udifluvents
Treaty	Fine-silty, mixed, mesic Typic Argiaquolls
Washtenaw	Fine-loamy, mixed, nonacid, mesic Typic Haplaquents
Wawasee	Fine-loamy, mixed, mesic Typic Hapludalfs

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