United States Department of Agriculture

Natural Resources Conservation Service

In cooperation with Michigan Department of Agriculture, Michigan Agricultural Experiment Station, Cooperative Extension Service, and Michigan Technological University

Soil Survey of Hillsdale County, Michigan

How To Use This Soil Survey

General Soil Map

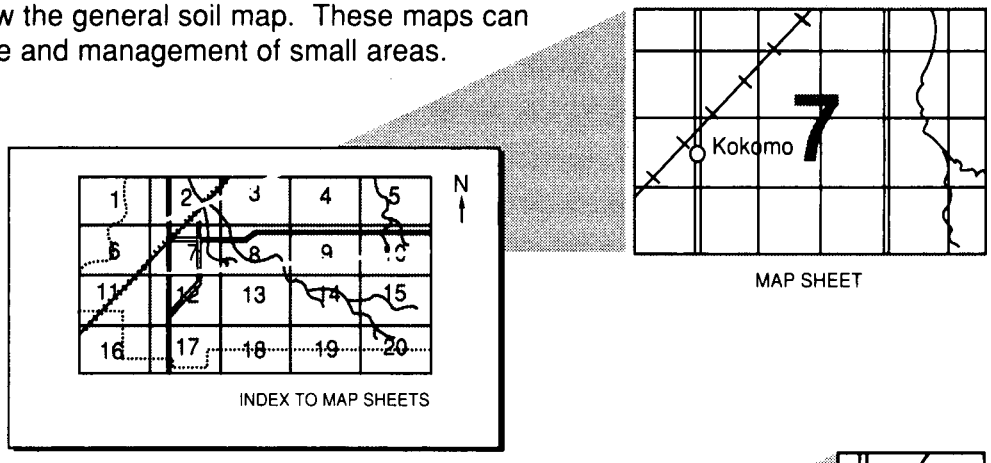
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

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

Detailed Soil Maps

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

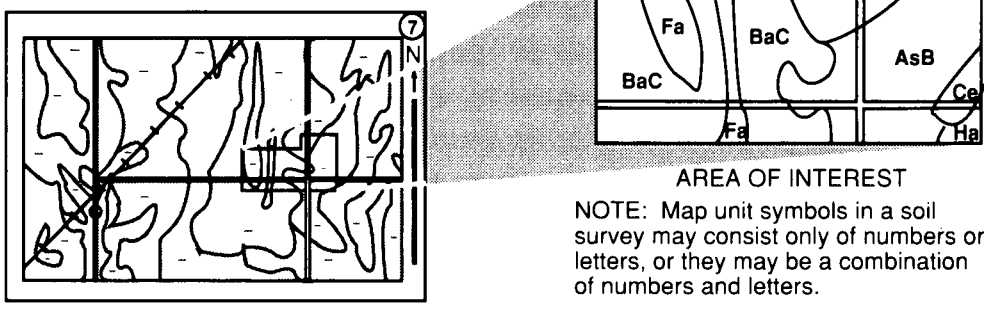
To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



INDEX TO MAP SHEETS

MAP SHEET

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



MAP SHEET

AREA OF INTEREST

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

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

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1990. Soil names and descriptions were approved in 1990. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1990. This survey was made cooperatively by the Natural Resources Conservation Service, Michigan Department of Agriculture, Michigan Agricultural Experiment Station, Cooperative Extension Service, and Michigan Technological University. It is part of the technical assistance furnished to the Hillsdale County Soil Conservation District. Financial assistance was provided by the Hillsdale County Board of Commissioners.

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Cover: Contour stripcropping of corn and alfalfa hay in an area of Hillsdale-Riddles complex, 6 to 12 percent slopes, eroded. Also shown are corn and winter wheat in an area of Hillsdale-Riddles complex, 2 to 6 percent slopes.

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Issued 1997

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Foreword

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

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

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

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

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Soil Survey of Hillsdale County, Michigan

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United States Department of Agriculture, Natural Resources Conservation Service, in cooperation with
the Michigan Department of Agriculture, Michigan Agricultural Experiment Station, Cooperative Extension Service, and Michigan Technological University

HILLSDALE COUNTY is in the south-central part of the Lower Peninsula of Michigan (fig. 1). It has an area of 388,166 acres, or about 606 square miles. Hillsdale, the county seat, is the commercial, industrial, and educational center of the county. The population of the county in 1980 was about 42,072.

About 77 percent of the land in the county is used for cash crops, dairy farming, or other farm enterprises. The chief cash crops are corn, soybeans, and winter wheat. About 13 percent of the land is woodland. About 8 percent of the land is urban or built-up land or is used for transportation, and 2 percent of the acreage in the county is water (USDA, 1982).

There are about 37 different kinds of soil in the county. The soils range widely in texture, natural drainage, slope, and other characteristics. Well drained soils make up about 51 percent of the county; moderately well drained soils, 11 percent; somewhat poorly drained soils, 19 percent; poorly drained and very poorly drained, mineral soils, 9 percent; and very poorly drained, organic soils, 8 percent. The rest of the county is miscellaneous areas and water areas.

This survey updates the soil surveys of Hillsdale County published in 1928 and 1977 (Veatch and others, 1928; Laurin and Whiteside, 1977). It provides additional information and has larger maps, which show the soils in greater detail.

General Nature of the County

This section provides general information about the county. It describes climate, history and development, farming, industry and transportation facilities, physiography and geology, and lakes and streams.

Climate

Table 1 gives data on temperature and precipitation for the survey area as recorded at Hillsdale in the period 1951 to 1980. 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 24.8 degrees F and the average daily minimum temperature is 16.7 degrees. The lowest temperature on record, which occurred at Hillsdale on January 4, 1981, is -21 degrees. In summer, the average temperature is 68.6 degrees and the average daily maximum temperature is 80.6 degrees. The highest recorded temperature, which occurred at Hillsdale on July 14, 1936, is 107 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive

Figure 1.—Location of Hillsdale County in Michigan.

plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 37.75 inches. Of this, 21.71 inches, or about 58 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 18.51 inches. The heaviest 1-day rainfall during the period of record was 6.07 inches at Hillsdale on June 26, 1978. Thunderstorms occur on about 39 days each year.

The average seasonal snowfall is 57.3 inches. The greatest snow depth at any one time during the period of record was 19 inches. On the average, 76 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 64 percent. Humidity is higher at night, and the average at dawn is about 85 percent. The sun shines 67 percent of the time possible in summer and 37 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, 11.9 miles per hour, in January.

History and Development

In 1821, a treaty with the Pottawattomie Indians granted lands to the United States Government. These lands included the area that is now Hillsdale County. Lake Baw Beese was named after the chief of the tribe. In 1827, shortly after the Chicago Turnpike was surveyed through the county, the first settlers arrived. Hillsdale County was established in 1829. Its name is derived from the local topography of hills and dales. The county seat was established in 1831 at Jonesville but was moved to Hillsdale in 1843. In 1836, the Toledo War settled the border dispute between Ohio and Michigan and thereby defined the southern boundary of Hillsdale County.

Hillsdale County has within its borders the headwaters of five of Michigan's major rivers. These rivers and the water-powered mills along them provided the county with its first industrial base. The first mill was built in 1832. The 1840's and 1850's were a major growth period in Hillsdale County. During this time the county seat was established, Hillsdale became the western railhead in Michigan, and Hillsdale College was dedicated. The Hillsdale County Fair was established in 1851.

The county continued to grow and prosper. Lake Baw Beese became a major resort area around the turn of the 20th century. Oil was discovered in 1957 (Hillsdale County Historical Society, 1976). Presently, industry and agriculture continue to expand and marginal lands are being converted to recreational uses.

Farming

The native vegetation in the survey area was a heavy growth of hardwoods and pines. After the trees were cut and the stumps removed, the land was cultivated.

General farming and livestock farming were very profitable during the early years of the county's history. They accounted for the major part of the county's income. As the land was cleared, the acreage used for farming increased. From the 1830's to the 1930's, the number of farms and the acreage of farmland increased rapidly. Since the 1930's, however, the number of farms has decreased. The average acreage of cultivated land per farm has increased. In 1902, the county had about 1,354 farms, which made up a total of 264,630 acres and had an average size of 195 acres (Michigan Department of Agriculture, 1988).

The Hillsdale County Soil Conservation District was organized in 1944. The district was formed for the purpose of assisting landowners in controlling erosion, maintaining or improving productivity, improving water quality, and preventing pollution.

The main agricultural enterprises are cash-grain farming, dairy farming, and raising hogs, sheep, and beef cattle. In 1987, about 82,900 acres was planted to corn for grain, 7,500 acres to corn for silage, 12,000 acres to wheat, 42,000 acres to soybeans, and 6,200 acres to oats.

Hillsdale County is ranked among the top 10 in the state in the production of corn, soybeans, sheep and lambs, hogs, beef cattle, and hens and pullets of laying age (Michigan Department of Agriculture, 1988).

Because of the suitability of the soils for a variety of crops, the favorable climatic conditions, and favorable markets, farming will continue to be a major part of the local economy.

Industry and Transportation Facilities

Industry, manufacturing, and retail trades are important enterprises in Hillsdale County. About 100 industrial and manufacturing firms are established in the county. Many of them employ 50 persons or fewer, but a number of the larger establishments have more than 300 employees.

The centers of industry and manufacturing are Hillsdale, Jonesville, North Adams, Reading, Litchfield, and Waldron. Many of the small towns and villages have two or three manufacturing firms. Some industrial and manufacturing firms are located in the rural areas. Molded plastic parts, tubing assemblies, playground and sports equipment, automotive assemblies, gears and components, food products, instruments, electronic equipment, and tools are among the products produced (Consumers Power Company, 1981). The county also has a number of oil wells.

The Hillsdale County Railroad is owned by the county and is joined to the major trunk lines. It forms a network connecting all of the major population centers in the county. It transports freight only.

U.S. Highway 12, the old Chicago Turnpike, crosses the northern part of the county from east to west, and U.S. Highway 127 runs along the east side of the county. These highways connect the county with the major interstate highways and the nearby large cities of Jackson, Coldwater, and Ann Arbor. State Highways M-49, M-99, and M-34 link most of the towns and villages in the county to the interstate, to the U.S. Highways, and to all points in the state. An excellent system of county roads also serves the county.

The Hillsdale Municipal Airport provides charter passenger service and freight service as well as service for private planes.

Physiography and Geology

Glacial drift is between 3 feet and 300 feet thick over most of the county. This glacial veneer is the result of at least four advances of continental glaciation. Only the deposits of the last stage, which was the Wisconsin stage, remain exposed at the surface. This last ice sheet melted and receded from the area about 14,000 years ago. The surface features in the county are a result of this glacial action.

Hillsdale County was covered alternately by both the Saginaw Lobe and the Erie Lobe of the glacier. The contact zone between the two lobes runs diagonally from Somerset Township to Camden Township (Martin, 1957). The major geographic landforms developed by this glaciation are till plains, moraines, glacial spillways, and interlobate moraine areas (Veatch and others, 1928).

In places where the glacial ice melted while stagnant, gently sloping till plains were formed. The till plains are small because of the activity of the two lobes advancing and retreating against each other. If the lobes had melted while advancing, they would have formed moraines or other similar steeper rolling and hilly areas. Moraines and similar landforms are common in the county.

The Saginaw Lobe carried material derived mainly from acid sandstone, and thus it produced soils that are generally sandy or sandy loam. The Erie Lobe carried material derived mainly from limestone. The soils that formed in this material are loamy and clayey and have a relatively high pH. The areas where the two lobes of the glacier met are called interlobate areas. The materials in these areas are juxtaposed, overlapping, or mixed, and thus the texture of the resultant material is variable, both horizontally and vertically. The location of the interlobate areas helps to explain the relative consistency of soil materials in the southeastern and northwestern parts of the county and the diverse textures of the soil materials in the central part.

Overlying these features and cutting across them are the glacial spillways. The texture of the resultant material and the shape of the deposit were determined by the volume and velocity of the meltwater and the texture of the source material. Generally, the faster the flow of water and the closer to the source of the material, the coarser the texture of the soil material. These deposits formed terraces and outwash plains, and all streams that presently follow these courses are greatly underfit.

Many of the lakes in Hillsdale County are a result of blocks of ice left behind as the glacier retreated. These iceblocks were subsequently buried by the material in the outwash. When the iceblocks melted, they left

depressions that are now filled with water. Examples are Baw Beese Lake and the lakes along Hog Creek.

The bedrock of Hillsdale County consists of the eroded edges of the bowl-like formation that makes up the Michigan basin. The oldest rock directly beneath the glacial drift veneer is the Coldwater Shale, which underlies the entire county and is the uppermost bedrock in the southern and eastern parts. It is overlapped in the central and northern half of the county by Marshall Sandstone. In some places the Marshall Formation is exposed or is very near the surface (Martin, 1957).

Lakes and Streams

Hillsdale County has about 350 ponds and 42 inland lakes and reservoirs. Many have less than 3 acres of surface water, but 15 are more than 100 acres in size (Freidhoff, 1968). Among the larger lakes are Baw Beese Lake, Lake Lee Ann, Lake Somerset, Long Lake, and Lake Diane. These lakes are more than 200 acres in size.

Hillsdale County is the highest area in south-central Michigan. It contains the headwaters of five of Michigan's major rivers. In the Lake Erie watershed, which drains the southern and eastern parts of the county, are the headwaters of the St. Joseph of the Maumee River and the Raisin River. In the Lake Michigan watershed, which drains the northern part of the county, are the Kalamazoo River and the Grand River. The St. Joseph River drains the western and southern parts of the county. The major creeks in the county are Sand Creek, Hog Creek, Bean Creek, Silver Creek, Laird Creek, and Bird Creek.

How This Survey Was Made

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

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

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

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

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

assembled from farm records and from field or plot experiments on the same kinds of soil.

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

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

Some of the boundaries on the soil maps of this soil survey do not match those on the maps of the surveys of adjacent counties, and some of the soil names and descriptions do not fully agree. Differences are the result of modifications or refinements in soil series concepts or of variations in the intensity of mapping or in the extent of the soils in the survey areas.

Map Unit Composition

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

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

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

The section "Survey Procedures" explains specific procedures used to make this survey.

Survey Procedures

The general procedures followed in making this survey are described in the National Soil Survey Handbook and the Soil Survey Manual (USDA, 1993) of the Natural Resources Conservation Service.

Before traversing the landscape, the soil scientists compared each map sheet to the U.S.G.S. topographic map for the area and stereoscopically plotted preliminary boundaries of slopes and landforms on aerial photographs. Traverses were made on foot. Most were made at intervals of about one-eighth mile. Traverses or random observations were made at closer intervals in areas of high variability.

Soil examinations along the traverses were made each one-eighth mile, or wherever obvious soil boundaries were crossed. Observations of such items as landforms, blown-down trees, vegetation, and roadbanks were made continuously without regard to spacing. Soil boundaries were determined on the basis of soil examinations, observations, and photo interpretation. The soil material was examined with the aid of a hand auger or a spade to a depth of about 5 feet. The pedons described as typical were observed and studied in pits.

Samples for chemical and physical analyses were taken from the site of the typical pedon for some of the major soils in the survey area. The analyses were made

by the National Soil Survey Laboratory at Lincoln, Nebraska. The results of the analyses are stored in a computerized data file at the laboratory. The results and the laboratory procedures can be obtained by request from the laboratory.

General Soil Map Units

The general soil map in this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

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

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

Soil Descriptions

1. Riddles-Hillsdale Association

Gently sloping to steep, very deep, well drained, loamy soils on ground moraines and end moraines

This association is on broad plains, knolls, foot slopes, back slopes, shoulder slopes, and ridges. Slopes range from 2 to 35 percent. Slopes are steeper along major drainageways and streams.

This association makes up about 25 percent of the survey area. It is about 40 percent Riddles and similar soils, 28 percent Hillsdale and similar soils, and 32 percent soils of minor extent (fig. 2).

Typically, the surface layer of the Riddles soils is very dark grayish brown sandy loam about 10 inches thick. The subsurface layer is yellowish brown sandy loam about 7 inches thick. The subsoil is dark yellowish brown, firm sandy clay loam and sandy loam about 23 inches thick. The substratum to a depth of about 60 inches is brown sandy loam.

Typically, the surface layer of the Hillsdale soils is dark grayish brown sandy loam about 9 inches thick. The subsoil is about 34 inches thick. It is friable. The upper part is dark yellowish brown sandy loam, and the lower part is strong brown sandy clay loam and sandy loam. The substratum to a depth of about 60 inches is yellowish brown fine sandy loam.

Of minor extent in this association are the well drained, sandy Spinks soils in landscape positions similar to those of the major soils; the somewhat poorly drained Locke soils in broad, low, flat areas and on foot slopes; and the very poorly drained Aquents, Histosols, and Houghton soils in depressions.

Most areas of this association are used as cropland. A few areas, mostly the steeper ones, are used as pasture or woodland.

The soils in this association are well suited to crops. Corn, soybeans, and winter wheat are the major crops. The major management concern is controlling water erosion and wind erosion.

These soils are well suited to use as pasture and hayland. The major forage species are alfalfa and smooth bromegrass. The hazards of water erosion and wind erosion are management concerns if overgrazing is allowed.

These soils are well suited to woodland. The hazard of erosion and the equipment limitations are management concerns in the moderately steep and steep areas.

These soils are suited to onsite waste disposal systems and to most kinds of building site development. The slope limits the use of these soils as septic tank absorption fields or for building site development. Also, the shrink-swell potential of the Riddles soils is a limitation on building sites.

2. Miami-Williamstown-Conover Association

Nearly level to steep, very deep, well drained to somewhat poorly drained, loamy soils on ground moraines and end moraines

This association consists of soils on broad plains, knolls, foot slopes, back slopes, shoulder slopes, and ridges. Slopes range from 1 to 12 percent. Slopes are generally steeper along major drainageways and streams.

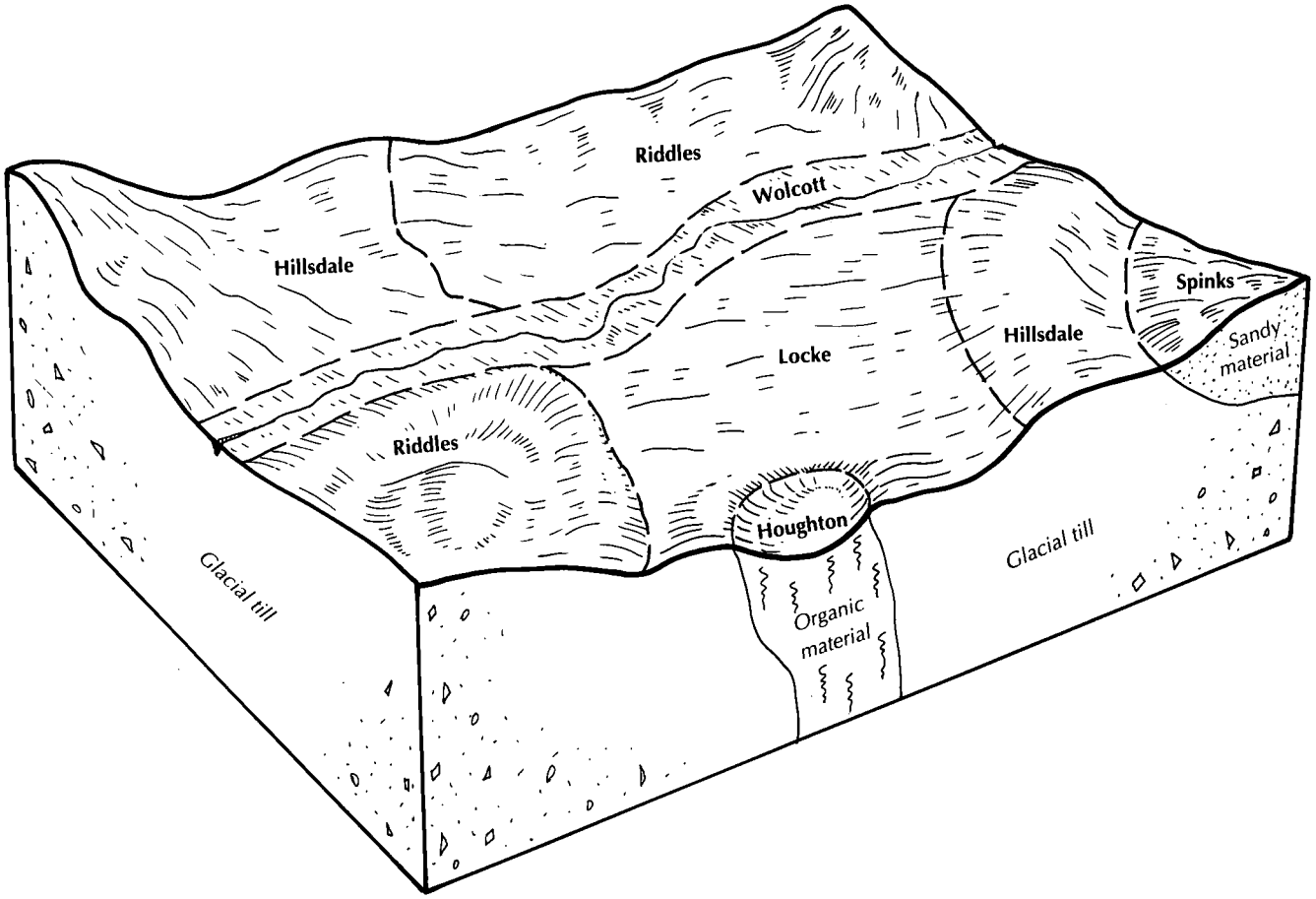

Figure 2.—Typical pattern of soils and parent material in the Riddles-Hillsdale association.

This association makes up about 28 percent of the survey area. It is about 27 percent Miami and similar soils, 23 percent Williamstown and similar soils, 20 percent Conover and similar soils, and 30 percent soils of minor extent (fig. 3).

The Miami soils are gently rolling to steep and are well drained. Typically, the surface layer is dark brown loam about 6 inches thick. The subsoil is dark yellowish brown and yellowish brown, firm clay loam and loam about 32 inches thick. The substratum to a depth of about 60 inches is yellowish brown loam.

The Williamstown soils are nearly level and undulating and are moderately well drained. Typically, the surface layer is dark grayish brown loam about 10 inches thick. The subsoil extends to a depth of about 60 inches. It is dark yellowish brown, firm clay loam in the upper part; dark yellowish brown and dark brown, mottled, very firm clay loam in the next part; and brown, mottled, very firm loam in the lower part.

The Conover soils are nearly level and undulating and are somewhat poorly drained. Typically, the surface layer is very dark gray loam about 9 inches thick. The subsoil is brown or dark brown, mottled, firm clay loam about 10 inches thick. The substratum to a depth of about 60 inches is mottled, brown loam.

Of minor extent in this association are the excessively drained, sandy Coloma soils and the well drained Steamburg soils in landscape positions similar to those of the Miami soils; the somewhat poorly drained Matherton soils on foot slopes and in low, flat areas; and the very poorly drained Histosols, Aquents, and Houghton soils in depressions.

Most areas of this association are used as cropland. Some of the steeper areas are used as pasture or woodland.

The soils in this association are well suited to use as cropland. Corn, soybeans, and winter wheat are the major crops. The major management concerns are controlling water erosion, reducing wetness, minimizing surface compaction, and maintaining tilth.

These soils are well suited to use as pasture and hayland. The major forage species are alfalfa and

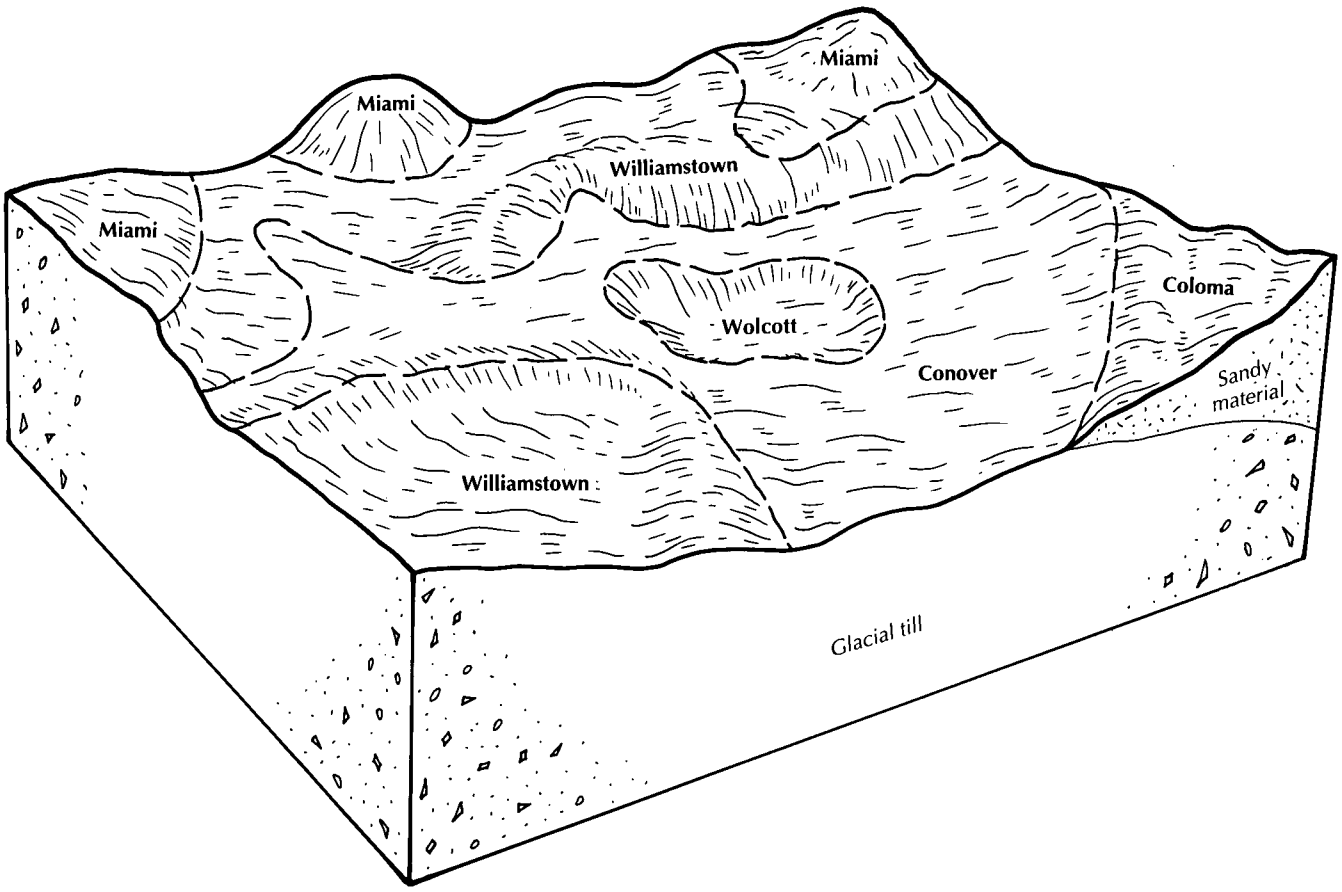

Figure 3.—Typical pattern of soils and parent material in the Miami-Williamstown-Conover association.

smooth bromegrass. Accelerated water erosion is a hazard if overgrazing is allowed in areas of the Miami soils. In areas of the Williamstown and Conover soils, grazing during wet periods causes surface compaction.

These soils are well suited to woodland. Equipment limitations caused by wetness are concerns in areas of the Conover soils. The erosion hazard and the equipment limitations caused by the slope are management concerns in the hilly and steep areas of the Miami soils.

The Miami and Williamstown soils can be used for onsite waste disposal systems and most kinds of building site development. The slope, moderately slow permeability, and the depth to the water table affect the use of these soils as septic tank absorption fields. The slope, the shrink-swell potential, and the depth to the water table are concerns on building sites. The Conover soils are generally unsuited to building site development and septic tank absorption fields because of a high water table.

3. Morley-Glynwood-Blount Association

Nearly level to steep, very deep, well drained to somewhat poorly drained, clayey soils on ground moraines and end moraines

This association consists of soils on broad plains, knolls, foot slopes, back slopes, shoulder slopes, and ridges. Slopes range dominantly from 0 to 35 percent. Slopes are generally steeper along major drainageways and streams.

This association makes up about 14 percent of the survey area. It is about 34 percent Morley and similar soils, 30 percent Glynwood and similar soils, 26 percent Blount and similar soils, and 10 percent soils of minor extent.

The Morley soils are gently rolling to steep and are well drained. Typically, the surface layer is dark brown loam about 6 inches thick. The subsoil is dark yellowish brown, firm clay loam about 25 inches thick. The substratum to a depth of about 60 inches is mottled, brown clay loam.

The Glynwood soils are nearly level and undulating and are moderately well drained. Typically, the surface layer is brown clay loam about 7 inches thick. The subsoil is about 19 inches thick. It is firm. The upper part is dark brown clay loam, and the lower part is mottled, dark brown clay and clay loam. The substratum to a depth of about 60 inches is mottled, grayish brown clay loam.

The Blount soils are nearly level and undulating and are somewhat poorly drained. Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsoil extends to a depth of about 60 inches. It is mottled and firm. The upper part is brown silty clay loam, and the lower part is dark yellowish brown clay loam.

Of minor extent in this association are the well drained, coarser textured Steamburg soils in landscape positions similar to those of the Morley soils; the poorly drained Pewamo soils in depressions; and the very poorly drained Edwards and Houghton soils in closed depressions.

Most areas of this association are used as cropland. A few areas, mostly the steeper ones, are used as pasture or woodland.

The soils in this association are well suited to crops. Corn, soybeans, and winter wheat are the major crops. The major management concerns are controlling water erosion, reducing wetness, minimizing surface compaction, and maintaining tilth.

These soils are well suited to use as pasture and hayland. The major forage species are alfalfa and smooth bromegrass. Accelerated water erosion is a hazard in overgrazed areas of the Morley soils. In areas of the Glynwood and Blount soils, grazing during wet periods causes surface compaction.

These soils are well suited to woodland. Plant competition, equipment limitations, and seedling mortality are concerns in areas of the Blount soils. The hazard of erosion and equipment limitations caused by the slope are concerns in the hilly and steep areas of the Morley soils.

The Morley and Glynwood soils can be used for most kinds of building site development. The slope, the shrink-swell potential, and the depth to the water table affect the use of these soils for building site development. The Blount soils are generally unsuited to building site development because of a high water table. All of the major soils are generally unsuited to use as septic tank absorption fields because of slow permeability, the depth to the water table, and the slope.

4. Blount-Pewamo-Matherton Association

Nearly level and undulating, very deep, somewhat poorly drained and poorly drained, clayey and loamy soils on outwash plains and on ground moraines

This association consists of soils on broad plains and on foot slopes and in low, flat areas and depressions. Slopes range from 0 to 4 percent.

This association makes up about 8 percent of the survey area. It is about 50 percent Blount and similar soils, 20 percent Pewamo and similar soils, 15 percent Matherton and similar soils, and 15 percent soils of minor extent.

The Blount soils are nearly level and undulating and are somewhat poorly drained. Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsoil extends to a depth of about 60 inches. It is mottled and firm. It is brown silty clay loam in the upper part and dark yellowish brown clay loam in the lower part.

The Pewamo soils are nearly level and are poorly drained. Typically, the surface layer is very dark grayish brown silt loam about 11 inches thick. The subsoil is mottled, grayish brown and dark grayish brown, firm clay loam about 37 inches thick. The substratum to a depth of about 60 inches is mottled, gray clay loam.

The Matherton soils are nearly level and undulating and are somewhat poorly drained. Typically, the surface layer is dark brown loam about 9 inches thick. The subsoil is mottled, dark yellowish brown and dark grayish brown, friable sandy clay loam and gravelly loam about 16 inches thick. The substratum to a depth of about 60 inches is grayish brown and dark gray, stratified gravelly coarse sand and fine sand.

Of minor extent in this association are the moderately well drained Glynwood soils on low knolls and the very poorly drained Edwards and Houghton soils in depressions.

Most areas of this association are used as cropland. A few areas are used as pasture and hayland.

The soils in this association are well suited to crops. Corn, soybeans, and winter wheat are the major crops. The major management concerns are minimizing surface compaction, maintaining tilth, and reducing wetness.

These soils are well suited to use as pasture and hayland. The major forage species are alfalfa and bromegrass. Grazing when the soils are wet causes surface compaction.

These soils are suited to woodland. The windthrow hazard, seedling mortality, equipment limitations caused by wetness, and plant competition are management concerns.

These soils are generally unsuited to use as septic tank absorption fields and building sites because of slow permeability, the depth to the water table, and the shrink-swell potential.

5. Fox-Boyer Association

Nearly level to steep, very deep, well drained sandy loams and loamy sands on outwash plains

This association consists of soils on broad plains, knolls, foot slopes, back slopes, shoulder slopes, and ridges. Slopes range from 1 to 35 percent. Slopes are steeper along major drainageways and streams.

This association makes up about 20 percent of the survey area. It is about 48 percent Fox and similar soils, 21 percent Boyer and similar soils, and 31 percent soils of minor extent.

Typically, the surface layer of the Fox soils is dark brown sandy loam about 8 inches thick. The subsurface layer also is dark brown sandy loam. It is about 3 inches thick. The subsoil is about 27 inches thick. The upper part is dark brown, friable sandy loam. The next part is dark brown, friable and firm gravelly sandy loam and gravelly sandy clay loam. The lower part is dark yellowish brown, loose sand and gravel. The substratum to a depth of about 60 inches is brown and dark brown sand and gravel.

Typically, the surface layer of the Boyer soils is dark brown loamy sand about 11 inches thick. The subsurface layer is dark yellowish brown gravelly loamy sand about 5 inches thick. The subsoil is about 14 inches thick. The upper part is brown and dark brown, friable gravelly sandy loam, and the lower part is strong brown, loose loamy sand. The substratum to a depth of about 60 inches is brown coarse sand and very gravelly coarse sand.

Of minor extent in this association are the sandy, excessively drained Coloma soils; the sandy, well drained Spinks soils; the loamy, well drained Hillsdale soils; and the loamy-skeletal Leoni soils. All of these soils are in landscape positions similar to those of the major soils. Other minor soils include the somewhat poorly drained Matherton soils on foot slopes and in low flat areas; the poorly drained Sebewa and Gilford soils in depressions; and the very poorly drained Aquents, Histosols, and Houghton soils in depressions.

Most areas of this association are used as cropland. A few areas, mostly the steeper ones, are used as pasture or woodland.

The soils in this association are moderately suited to crops. Corn, soybeans, and winter wheat are the major crops. The major management concerns are controlling water erosion and wind erosion and conserving soil moisture.

These soils are well suited to pasture and hayland. The major forage species are alfalfa, red clover, bromegrass, and orchardgrass. Water erosion and wind erosion are concerns if overgrazing is allowed.

These soils are well suited to woodland.

These soils are well suited to most kinds of building site development. The slope is a limitation. The soils are poorly suited to use as septic tank absorption fields. They readily absorb but do not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

6. Coloma-Matherton-Gilford Association

Nearly level to steep, very deep, excessively drained to poorly drained, sandy and loamy soils on outwash plains

This association consists of soils on broad plains, knolls, foot slopes, back slopes, shoulder slopes, and ridges and in depressions and low lying areas. Slopes range from 0 to 35 percent.

This association makes up about 3 percent of the survey area. It is about 44 percent Coloma and similar soils, 18 percent Matherton and similar soils, 10 percent Gilford and similar soils, and 28 percent soils of minor extent (fig. 4).

The Coloma soils are nearly level to steep and are excessively drained. Typically, the surface layer is dark grayish brown sand about 9 inches thick. The subsurface layer is dark yellowish brown sand about 26 inches thick. The subsoil to a depth of about 60 inches is yellowish brown, loose sand and has thin bands of dark yellowish brown loamy sand.

The Matherton soils are nearly level and undulating and are somewhat poorly drained. Typically, the surface layer is dark brown loam about 9 inches thick. The subsoil is mottled, dark yellowish brown and dark grayish brown, friable sandy clay loam and loam about 16 inches thick. The substratum to a depth of about 60 inches is grayish brown and dark gray, stratified gravelly coarse sand and fine sand.

The Gilford soils are nearly level and are poorly drained. Typically, the surface layer is black and very dark gray sandy loam about 16 inches thick. The subsoil is grayish brown and light brownish gray, mottled, friable sandy loam about 20 inches thick. The substratum to a depth of about 60 inches is grayish brown and gray loamy sand and stratified sand and gravel.

Of minor extent in this association are the sandy, well drained Boyer soils and the loamy, well drained Fox soils in landscape positions similar to those of the Coloma soils; the somewhat poorly drained Thetford soils on foot slopes and in low, flat areas; the very poorly drained Sloan and Glendora soils on flood plains;

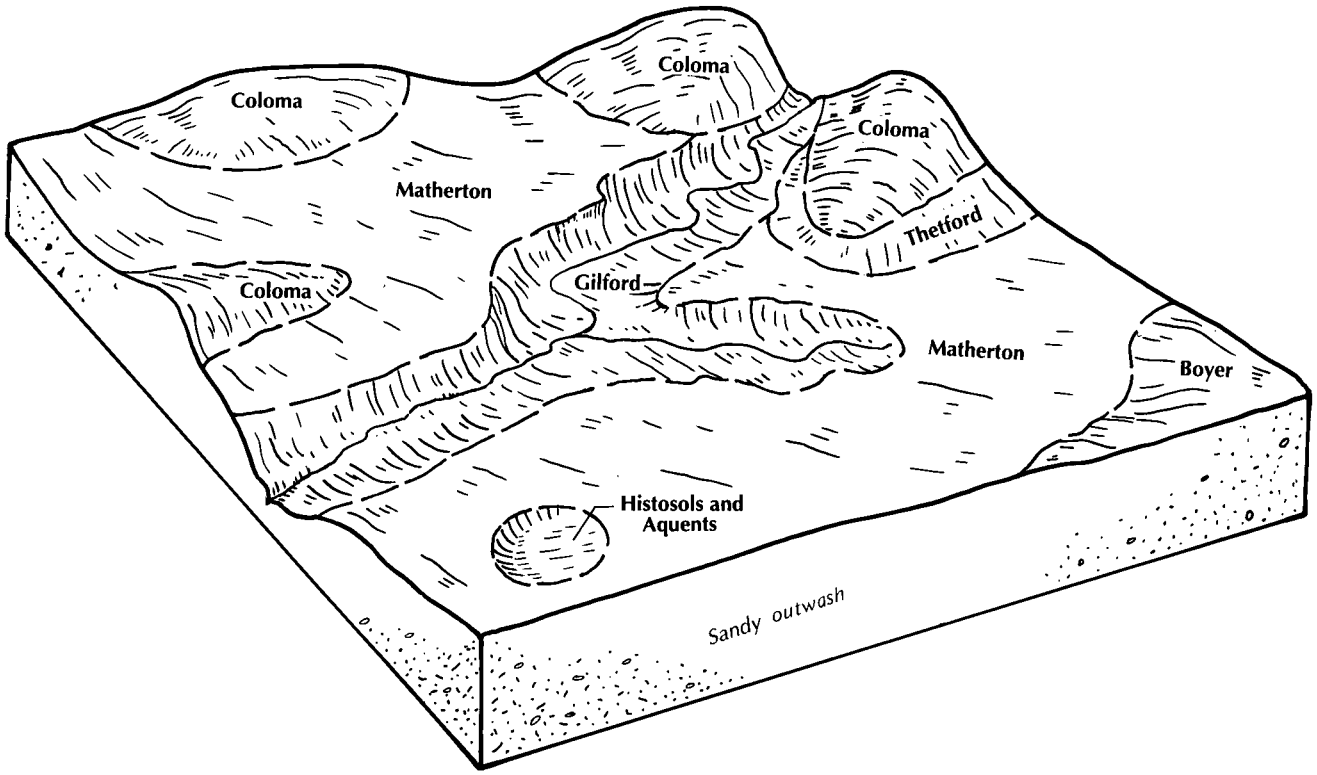

Figure 4.—Typical pattern of soils and parent material in the Coloma-Matherton-Gilford association.

and the very poorly drained Aquents, Histosols, and Houghton soils in depressions.

Most areas of this association are used as cropland. Some of the steeper and wetter areas are used as pasture or woodland.

The Coloma and Matherton soils are moderately suited to crops. Corn, soybeans, and winter wheat are the major crops. The major management concerns in areas of these soils are controlling wind erosion, maintaining a high content of organic matter, and conserving soil moisture during dry periods. The Gilford soils are suited to crops if they are adequately drained. The major management concerns in areas of the Gilford soils are controlling wind erosion, reducing wetness, and conserving soil moisture during dry periods.

The soils in this association are moderately suited to use as pasture and hayland. The major forage species are alfalfa, red clover, bromegrass, and orchardgrass. Accelerated wind erosion is a hazard if overgrazing is allowed.

These soils are suited to woodland. The major management concerns are plant competition and seedling mortality. The windthrow hazard and equipment limitations caused by wetness are additional concerns in areas of the Gilford soils. The hazard of erosion and equipment limitations caused by the slope are additional concerns in the hilly and steep areas of the Coloma soils.

The Coloma soils are well suited to most kinds of building site development. The slope is a limitation. The Coloma soils are poorly suited to use as septic tank absorption fields. They readily absorb but do not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. The Matherton and Gilford soils are generally unsuited to building site development and septic tank absorption fields because of wetness.

7. Houghton-Gilford Association

Nearly level, very deep, very poorly drained and poorly drained, mucky and loamy soils on ground moraines, end moraines, outwash plains, and flood plains

This association consists of soils in depressional areas. Slopes range from 0 to 2 percent.

This association makes up about 2 percent of the survey area. It is about 66 percent Houghton and similar soils, 13 percent Gilford and similar soils, and 21 percent soils of minor extent.

The Houghton soils are very poorly drained.

Typically, the surface layer is black muck about 9 inches thick. The underlying layers to a depth of about 60 inches are black and very dark brown muck.

The Gilford soils are poorly drained. Typically, the surface layer is black and very dark gray sandy loam about 16 inches thick. The subsoil is grayish brown and light brownish gray, mottled, friable sandy loam about 20 inches thick. The substratum to a depth of about 60 inches is grayish brown and gray loamy sand and stratified sand and gravel.

Of minor extent in this association are the well drained Boyer, Fox, Hillsdale, Miami, and Riddles soils on adjacent knolls and ridges; the somewhat poorly drained Matherton soils in the slightly higher landscape positions; the poorly drained Wolcott and Sebewa soils in depressions; and the very poorly drained Edwards and Palms soils along the edges of lakes and in depressions.

Most areas of this association support a permanent cover of vegetation, including trees. These areas are used primarily for recreation and wildlife habitat.

The soils in this association are generally unsuited to building site development and septic tank absorption fields. Also, the Houghton soils are generally unsuited to use as cropland, pasture, and hayland because of wetness and a lack of suitable drainage outlets.

The Gilford soils are suited to crops if they are adequately drained. Corn, soybeans, and winter wheat are the major crops. The major management concerns are controlling wind erosion, reducing wetness, and conserving soil moisture during dry periods.

The Gilford soils are suited to use as pasture and hayland. The major forage species in pastured areas are birdsfoot trefoil, bromegrass, and reed canarygrass. Accelerated wind erosion is a hazard if overgrazing is allowed.

The soils in this association are suited to woodland. The major management concerns are seedling mortality, the windthrow hazard, equipment limitations caused by wetness, and plant competition.

Broad Land Use Considerations

The general soil map can help those who plan land use at the township, county, or watershed level. The soils in Hillsdale County vary widely in their suitability for major land uses.

Cropland

About 53 percent of the land in the county is used for cultivated crops, mainly corn, soybeans, and wheat. This cropland is widely spread throughout the county but is concentrated in associations 1, 2, 3, 4, and 5. The soils in these associations can be used for the common crops with little or no special management.

In association 1, crops are cultivated in the nearly level to strongly sloping areas in the uplands. The hazards of water erosion and wind erosion are the main management concerns in this association. In associations 2, 3, and 4, cultivated crops are grown in the nearly level to rolling areas. Controlling water erosion and wind erosion, minimizing surface compaction, removing excess water during wet periods, and maintaining good soil tilth are concerns in areas of these soils. In associations 5 and 6, crops are grown in the nearly level to rolling areas. Water erosion, wind erosion, and droughtiness are concerns in these areas. The very poorly drained organic soils in association 7 are generally not cultivated.

Pasture and Hayland

About 7 percent of the land in the county is permanent pasture, and 6 percent is in a tillage rotation system. The soils in associations 1, 2, 3, 4, 5, and 6 are generally suited to use as pasture and hayland. Most of the pasture is in rolling or strongly sloping to steep areas in the uplands. Maintaining a cover of pasture grasses helps to control erosion.

Woodland

About 13 percent of the county is woodland. Productivity of hardwoods is high and very high in areas of associations 1, 2, and 3. It is moderately high or high in associations 4 and 5, and it is moderately low or low in associations 6 and 7. Plant competition is the major concern affecting woodland management in Hillsdale County. The hazard of erosion, equipment limitations, seedling mortality, and the windthrow hazard are additional concerns in some areas.

Recreation

The soils are poorly suited to well suited to use as sites for recreation, depending on the intensity of the expected use. Most soils in associations 1, 2, 3, and 5 are generally suited to intensive recreational uses, such as playgrounds, camp areas, picnic areas, and paths and trails. Wetness is a limitation on the very poorly drained, poorly drained, and somewhat poorly drained soils in associations 2, 3, 4, 6, and 7. The sandy texture of the soils is an additional limitation in areas of association 7. The slope is a limitation in the rolling or strongly sloping to steep areas of associations 1, 2, 3, and 5. The soils in all of the associations are well suited to extensive recreational uses, such as hiking, hunting, and fishing.

Wildlife Habitat

The potential of the soils for use as wildlife habitat is generally high throughout the county. Associations 1, 2, 3, 4, 5, and 6 are generally suitable for use as habitat for openland and woodland wildlife. The poorly drained and somewhat poorly drained soils in associations 2, 3, 4, 6, and 7 are also suited to use as habitat for wetland wildlife.

Building Site Development

About 5 percent of the county is intensively used as urban land. The urban land is concentrated in associations 1 and 5.

The nearly level to rolling, excessively drained, well drained, and moderately well drained soils in associations 2, 3, 5, and 6 have slight or moderate limitations affecting most kinds of building site development but have moderate or severe limitations affecting their use as septic tank absorption fields. The slope, the shrink-swell potential, and either a poor filtering capacity or slow permeability are limitations.

If the soils in associations 4 and 7 are used as building sites, the seasonal high water table, the shrink-swell potential, and flooding are management concerns. The moderately well drained and well drained soils of minor extent in these associations are suited to most kinds of building site development and to use as septic tank absorption fields.

Detailed Soil Map Units

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

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

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

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

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

Some map units are made up of two or more major soils. These map units are called soil complexes or undifferentiated groups.

A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Williamstown-Conover complex, 1 to 6 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in the mapped areas are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. Histosols and Aquents, ponded, is an undifferentiated group in this survey area.

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

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

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil Descriptions

10B—Hillsdale-Riddles complex, 2 to 6 percent slopes

Setting

Landform: End moraines, ground moraines
Position on the landform: Broad plains and low knolls
Shape of areas: Irregular
Size of areas: 5 to 500 acres

Typical Profile

Hillsdale

Surface layer:
0 to 9 inches—dark grayish brown sandy loam

Subsoil:
9 to 15 inches—dark yellowish brown, friable sandy loam
15 to 28 inches—strong brown, friable sandy clay loam
28 to 43 inches—strong brown, friable sandy loam

Substratum:
43 to 60 inches—yellowish brown fine sandy loam

Riddles

Surface layer:
0 to 10 inches—very dark grayish brown sandy loam

Subsurface layer:
10 to 17 inches—yellowish brown sandy loam

Subsoil:
17 to 22 inches—dark yellowish brown, firm sandy loam
22 to 40 inches—dark yellowish brown, firm sandy clay loam

Substratum:
40 to 60 inches—brown sandy loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Slow
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Slight
Hazard of wind erosion: Moderate
Shrink-swell potential: Hillsdale—low; Riddles-moderate

Composition

Hillsdale soil and similar soils: 45 to 65 percent
Riddles soil and similar soils: 20 to 40 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained, sandy Spinks soils in landscape positions similar to those of the major soils
• The somewhat poorly drained Locke soils in drainageways and on foot slopes

Similar inclusions:
• Soils that have more sand in the lower part of the profile
• Areas that are moderately well drained

Use and Management

Land use: Dominant use—cropland; other uses—pasture, woodland, building sites

Cropland
Major management concerns: Wind erosion, water erosion, nutrient loss
Management measures:
• Crop rotations that include grasses and legumes and small grain help to control runoff and water erosion.
• Properly regulating the application of irrigation water helps to control runoff and water erosion.
• Conservation tillage and crop residue management help to control wind erosion.
• Conservation tillage systems, contour farming, cover crops, and sod-based rotations minimize the detachment and loss of nutrients associated with sediment, thus minimizing the losses of solid-phase nitrogen and phosphorus.

Pasture
Major management concerns: Overgrazing
Management measures:
• Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: None

Buildings
Major management concerns: The shrink-swell potential of the Riddles soil
Management measures:
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.

Septic tank absorption fields
Major management concerns: Restricted permeability
Management measures:
• Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: Hillsdale—4A; Riddles—5A
Michigan soil management group: 3a

10C2—Hillsdale-Riddles complex, 6 to 12 percent slopes, eroded

Setting

Landform: End moraines, ground moraines
Position on the landform: Knolls and foot slopes
Distinctive landscape features: Eroded surface
Shape of areas: Irregular

Size of areas: 5 to 500 acres

Typical Profile

Hillsdale

Surface layer:
0 to 7 inches—dark grayish brown sandy loam
Subsoil:
7 to 15 inches—dark yellowish brown, friable sandy loam
15 to 28 inches—strong brown, friable sandy clay loam
28 to 43 inches—strong brown, friable sandy loam
Substratum:
43 to 60 inches—yellowish brown fine sandy loam

Riddles

Surface layer:
0 to 8 inches—very dark grayish brown sandy loam
Subsurface layer:
8 to 12 inches—yellowish brown sandy loam
Subsoil:
12 to 22 inches—dark yellowish brown, firm sandy loam
22 to 40 inches—dark yellowish brown, firm sandy clay loam
Substratum:
40 to 60 inches—brown sandy loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Medium
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Moderate
Hazard of wind erosion: Moderate
Shrink-swell potential: Hillsdale—low; Riddles—moderate

Composition

Hillsdale soil and similar soils: 45 to 60 percent
Riddles soil and similar soils: 25 to 45 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained, sandy Spinks soils in landscape positions similar to those of the major soils
• The somewhat poorly drained Locke soils in drainageways and on foot slopes
Similar inclusions:
• Soils that have more sand in the lower part of the profile
• Areas that are not eroded

Use and Management

Land use: Dominant uses—cropland, pasture; other uses—woodland, building sites

Cropland

Major management concerns: Water erosion, wind erosion, nutrient loss
Management measures:
• Conservation tillage and crop rotations that include small grain help to prevent excessive soil loss.
• Grassed waterways, water- and sediment-control basins, diversions, and grade-stabilization structures help to prevent gully erosion.
• Contour farming, contour stripcropping, and terraces reduce the runoff rate and help to control water erosion.
• Properly regulating the application of irrigation water helps to control runoff and water erosion.
• Conservation tillage and crop residue management help to control wind erosion.
• Conservation tillage systems, contour farming, cover crops, and sod-based rotations minimize the detachment and loss of nutrients associated with sediment, thus minimizing the losses of solid-phase nitrogen and phosphorus.

Pasture

Major management concerns: Overgrazing
Management measures:
• Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: None

Buildings

Major management concerns: Slope and the shrink-swell potential of the Riddles soil
Management measures:
• Some land grading may be needed.
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.

Septic tank absorption fields

Major management concerns: Slope, restricted permeability
Management measures:
• Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly.
• Enlarging or pressurizing the absorption field or

installing alternating drain fields helps to overcome the restricted permeability.

Interpretive Groups

Land capability classification: IIIe
Woodland ordination symbol: Hillsdale—4A; Riddles—5A
Michigan soil management group: 3a

10D2—Hillsdale-Riddles complex, 12 to 18 percent slopes, eroded

Setting

Landform: End moraines
Position on the landform: Back slopes
Shape of areas: Irregular
Distinctive landscape features: Eroded surface
Size of areas: 5 to 200 acres

Typical Profile

Hillsdale

Surface layer:
0 to 7 inches—dark grayish brown sandy loam
Subsoil:
7 to 15 inches—dark yellowish brown, friable sandy loam
15 to 28 inches—strong brown, friable sandy clay loam
28 to 43 inches—strong brown, friable sandy loam
Substratum:
43 to 60 inches—yellowish brown fine sandy loam

Riddles

Surface layer:
0 to 8 inches—very dark grayish brown sandy loam
Subsurface layer:
8 to 12 inches—yellowish brown sandy loam
Subsoil:
12 to 31 inches—dark yellowish brown, firm sandy loam
31 to 40 inches—dark yellowish brown, firm sandy clay loam
Substratum:
40 to 60 inches—brown sandy loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Rapid
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Severe
Hazard of wind erosion: Moderate
Shrink-swell potential: Hillsdale—low; Riddles—moderate

Composition

Hillsdale soil and similar soils: 45 to 60 percent
Riddles soil and similar soils: 30 to 45 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
- The well drained, sandy Spinks soils in landscape positions similar to those of the major soils
- The somewhat poorly drained Locke soils in drainageways and on foot slopes

Similar inclusions:
- Soils that have more sand in the lower part of the profile
- Areas that are not eroded
- Areas that are severely eroded

Use and Management

Land use: Dominant uses—cropland, pasture; other uses—woodland, building sites

Cropland

Major management concerns: Water erosion, wind erosion, nutrient loss
Management measures:
- Crop rotations that include grasses or legumes, conservation tillage, and cover crops help to control water erosion.
- Grassed waterways, water- and sediment-control basins, diversions, and grade-stabilization structures help to prevent gully erosion.
- Contour farming, contour stripcropping, and terraces reduce the runoff rate and help to control water erosion.
- Growing grasses and legumes for pasture or hay is effective in controlling erosion.
- Conservation tillage and crop residue management help to control wind erosion.
- Conservation tillage systems, contour farming, cover crops, and sod-based rotations minimize the detachment and loss of nutrients associated with sediment, thus minimizing the losses of solid-phase nitrogen and phosphorus.

Pasture

Major management concerns: Overgrazing
Management measures:
- Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.
- Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: None

Buildings
Major management concerns: Slope and the shrink-swell potential of the Riddles soil
Management measures:
• Buildings should be designed so that they conform to the natural slope of the land. Land shaping is necessary in some areas.
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.

Septic tank absorption fields
Major management concerns: Slope, restricted permeability
Management measures:
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.
• Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.

Interpretive Groups

Land capability classification: IVe
Woodland ordination symbol: Hillsdale—4A; Riddles—5A
Michigan soil management group: 3a

10E—Hillsdale-Riddles complex, 18 to 35 percent slopes

Setting

Landform: End moraines
Position on the landform: Shoulder slopes
Shape of areas: Linear
Size of areas: 5 to 100 acres

Typical Profile

Hillsdale

Surface layer:
0 to 9 inches—dark grayish brown sandy loam

Subsoil:
9 to 15 inches—dark yellowish brown, friable sandy loam
15 to 28 inches—strong brown, friable sandy clay loam
28 to 43 inches—strong brown, friable sandy loam

Substratum:
43 to 60 inches—yellowish brown fine sandy loam

Riddles

Surface layer:
0 to 10 inches—very dark grayish brown sandy loam

Subsurface layer:
10 to 17 inches—yellowish brown sandy loam

Subsoil:
17 to 31 inches—dark yellowish brown, firm sandy loam
31 to 40 inches—dark yellowish brown, firm sandy clay loam

Substratum:
40 to 60 inches—brown sandy loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Rapid
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Severe
Hazard of wind erosion: Moderate
Shrink-swell potential: Hillsdale—low; Riddles—moderate

Composition

Hillsdale soil and similar soils: 45 to 60 percent
Riddles soil and similar soils: 30 to 45 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained, sandy Spinks soils in landscape positions similar to those of the major soils
• The somewhat poorly drained Locke soils in drainageways and on foot slopes

Similar inclusions:
• Soils that have more sand in the lower part of the profile
• Areas that are eroded

Use and Management

Land use: Dominant use—pasture; other use—woodland

Cropland
Major management concerns: Slope
Management measures:
• Because of the slope, these soils are very difficult to manage and are generally not suited to cultivated crops.

Pasture
Major management concerns: Overgrazing, water erosion, wind erosion
Management measures:
• Growing grasses and legumes for pasture or hay is effective in controlling erosion.

• Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: Equipment limitations, erosion hazard
Management measures:
• Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
• Seeding skid roads, logging roads, and landings after the trees are logged helps to control erosion.
• Areas sensitive to erosion, esthetics, and drought conditions may require mulch, such as straw, bark, or wood chips.

Buildings
Major management concerns: Slope, shrink-swell
Management measures:
• Because of the slope, these soils are poorly suited to building site development unless extensive land shaping is applied.

Septic tank absorption fields
Major management concerns: Slope
Management measures:
• Because of the slope, these soils are generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: Hillsdale—VIIe; Riddles—VIe
Woodland ordination symbol: Hillsdale—4R; Riddles—5R
Michigan soil management group: 3a

11B—Eleva channery fine sandy loam, 2 to 6 percent slopes

Setting

Landform: Hillslopes
Position on the landform: Broad plains and low knolls
Shape of areas: Irregular
Size of areas: 3 to 120 acres

Typical Profile

Surface layer:
0 to 6 inches—dark yellowish brown channery fine sandy loam
Subsoil:
6 to 11 inches—dark yellowish brown, friable channery fine sandy loam
11 to 18 inches—dark yellowish brown, friable fine sandy loam
Substratum:
18 to 37 inches—dark yellowish brown very channery loamy fine sand
Bedrock:
37 inches—weakly cemented sandstone

Soil Properties and Qualities

Depth class: Moderately deep
Permeability: Moderate
Available water capacity: Low
Drainage class: Somewhat excessively drained
Depth to the water table: Greater than 6 feet
Surface runoff: Slow
Flooding: None
Organic matter content: Moderately low
Hazard of water erosion: Slight
Hazard of wind erosion: Slight
Shrink-swell potential: Low

Composition

Eleva soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The very deep, well drained Hillsdale and Riddles soils
Similar inclusions:
• Soils that have a surface layer of fine sandy loam or sandy loam
• Soils that contain more channers in the subsoil and substratum

Use and Management

Land use: Dominant use—pasture; other uses—cropland, woodland, building sites

Cropland
Major management concerns: Low available water capacity, nutrient loss
Management measures:
• Properly regulating the application of irrigation water helps to control runoff and water erosion.
• Timing fertilizer applications so that they meet crop nutrient needs, using split fertilizer applications, and applying fertilizer in bands may reduce the risk of nutrient leaching.
• Managing irrigation water reduces the amount of nitrogen leached from irrigated fields.
• Using a system of conservation tillage, leaving crop

residue on the surface, and adding other organic material conserve moisture.
• Drought-tolerant crops should be selected for planting, or the soil should be irrigated.

Pasture
Major management concerns: Low available water capacity
Management measures:
• Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: Windthrow hazard
Management measures:
• Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

Buildings
Major management concerns: Cutbanks cave
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields
Major management concerns: Thin layer, seepage, poor filter
Management measures:
• An alternative site should be selected.

Interpretive Groups

Land capability classification: IIIs
Woodland ordination symbol: 2D
Michigan soil management group: 3/Ra

11C—Eleva channery fine sandy loam, 6 to 12 percent slopes

Setting

Landform: Bedrock-controlled uplands
Position on the landform: Knolls and foot slopes
Shape of areas: Irregular
Size of areas: 3 to 120 acres

Typical Profile

Surface layer:
0 to 6 inches—dark yellowish brown channery fine sandy loam
Subsoil:
6 to 11 inches—dark yellowish brown, friable channery fine sandy loam
11 to 18 inches—dark yellowish brown, friable fine sandy loam
Substratum:
18 to 37 inches—dark yellowish brown very channery loamy fine sand
Bedrock:
37 inches—weakly cemented sandstone

Soil Properties and Qualities

Depth class: Moderately deep
Permeability: Moderate
Available water capacity: Low
Drainage class: Somewhat excessively drained
Depth to the water table: Greater than 6 feet
Surface runoff: Slow
Flooding: None
Organic matter content: Moderately low
Hazard of water erosion: Moderate
Hazard of wind erosion: Slight
Shrink-swell potential: Low

Composition

Eleva soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The very deep, well drained Hillsdale and Riddles soils in landscape positions similar to those of the Eleva soil
Similar inclusions:
• Soils that have a surface layer of fine sandy loam or sandy loam
• Soils that contain more channers in the subsoil and substratum

Use and Management

Land use: Dominant uses—cropland, pasture; other uses—woodland, building sites

Cropland
Major management concerns: Water erosion, low available water capacity
Management measures:
• Conservation tillage and crop rotations that include small grain help to prevent excessive soil loss.
• Grassed waterways, water- and sediment-control basins, diversions, and grade-stabilization structures help to prevent gully erosion.
• Contour farming, contour stripcropping, and terraces reduce the runoff rate and help to control water erosion.
• Properly regulating the application of irrigation water helps to control runoff and water erosion.
• Conservation tillage systems, contour farming, cover crops, and sod-based rotations minimize the detachment and loss of nutrients associated with sediment, thus minimizing the losses of solid-phase nitrogen and phosphorus.

• Using a system of conservation tillage, leaving crop residue on the surface, and adding other organic material conserve moisture.

Pasture
Major management concerns: Low available water capacity
Management measures:
• Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: Windthrow hazard
Management measures:
• Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

Buildings
Major management concerns: Slope, cutbanks cave
Management measures:
• Some land grading may be needed.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields
Major management concerns: Slope, thin layer, seepage, poor filter
Management measures:
• An alternative site should be selected.

Interpretive Groups

Land capability classification: IVe
Woodland ordination symbol: 2D
Michigan soil management group: 3/Ra

11D—Eleva channery fine sandy loam, 12 to 25 percent slopes

Setting

Landform: Bedrock-controlled uplands
Position on the landform: Back slopes, shoulder slopes, and ridgetops
Distinctive landscape features: Rock outcrop
Shape of areas: Irregular, linear
Size of areas: 3 to 80 acres

Typical Profile

Surface layer:
0 to 6 inches—dark yellowish brown channery fine sandy loam

Subsoil:
6 to 11 inches—dark yellowish brown, friable channery fine sandy loam
11 to 18 inches—dark yellowish brown, friable fine sandy loam

Substratum:
18 to 37 inches—dark yellowish brown very channery loamy fine sand

Bedrock:
37 to 43 inches—sandstone

Soil Properties and Qualities

Depth class: Moderately deep
Permeability: Moderate
Available water capacity: Low
Drainage class: Somewhat excessively drained
Depth to the water table: Greater than 6 feet
Surface runoff: Moderate
Flooding: None
Organic matter content: Moderately low
Hazard of water erosion: Moderate
Hazard of wind erosion: Slight
Shrink-swell potential: Low

Composition

Eleva soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The very deep, well drained Hillsdale and Riddles soils in landscape positions similar to those of the Eleva soil

Similar inclusions:
• Soils that have a surface layer of fine sandy loam or sandy loam
• Soils that contain more channers in the subsoil and substratum

Use and Management

Land use: Dominant use—pasture; other uses—cropland, woodland, building sites

Cropland
Major management concerns: Water erosion, low available water capacity
Management measures:
• Crop rotations that include grasses or legumes, conservation tillage, and cover crops help to control water erosion.
• Grassed waterways, water- and sediment-control basins, diversions, and grade-stabilization structures help to prevent gully erosion.
• Contour farming, contour stripcropping, and terraces reduce the runoff rate and help to control water erosion.
• Growing grasses and legumes for pasture or hay is effective in controlling erosion.
• Conservation tillage systems, contour farming, cover

crops, and sod-based rotations minimize the detachment and loss of nutrients associated with sediment, thus minimizing the losses of solid-phase nitrogen and phosphorus.
• Using a system of conservation tillage, leaving crop residue on the surface, and adding other organic material conserve moisture.

Pasture
Major management concerns: Low available water capacity
Management measures:
• Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: Equipment limitations, erosion hazard, windthrow hazard
Management measures:
• Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
• Seeding skid roads, logging roads, and landings after the trees are logged helps to control erosion.
• Areas sensitive to erosion, esthetics, and drought conditions may require mulch, such as straw, bark, or wood chips.
• Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

Buildings
Major management concerns: Slope, cutbanks cave
Management measures:
• Because of the slope, this soil is poorly suited to building site development unless extensive land shaping is applied.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields
Major management concerns: Slope, thin layer, seepage, poor filter
Management measures:
• An alternative site should be selected.

Interpretive Groups

Land capability classification: VIe
Woodland ordination symbol: 2R
Michigan soil management group: 3/Ra

12B—Williamstown-Conover complex, 1 to 6 percent slopes

Setting

Landform: End moraines, ground moraines
Position on the landform: Broad plains and low knolls
Shape of areas: Irregular
Size of areas: 5 to 1,500 acres

Typical Profile

Williamstown

Surface layer:
0 to 10 inches—dark grayish brown loam
Subsoil:
10 to 25 inches—dark yellowish brown, firm and very firm clay loam
25 to 33 inches—dark brown, mottled, very firm clay loam
33 to 60 inches—brown, mottled, very firm loam

Conover

Surface layer:
0 to 9 inches—very dark gray loam
Subsoil:
9 to 22 inches—dark brown, mottled, firm clay loam
22 to 27 inches—brown, mottled, firm clay loam
Substratum:
27 to 60 inches—brown, mottled loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately slow
Available water capacity: Moderate
Drainage class: Williamstown—moderately well drained; Conover—somewhat poorly drained
Seasonal high water table: Williamstown—perched at a depth of 1.5 to 3.5 feet from January through April; Conover—at a depth of 1 to 2 feet from November through May
Surface runoff: Williamstown—medium; Conover—slow
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Williamstown—moderate; Conover—slight
Hazard of wind erosion: Slight
Shrink-swell potential: Moderate

Composition

Williamstown soil and similar soils: 55 to 70 percent
Conover soil and similar soils: 25 to 40 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The very poorly drained Wolcott soils in depressions

• The well drained, coarser textured Steamburg soils in the slightly higher landscape positions

Similar inclusions:
• Areas that are eroded
• Soils that have a surface layer of sandy loam
• Areas that are well drained

Use and Management

Land use: Dominant use—cropland; other uses—pasture, woodland, building sites

Cropland
Major management concerns: Water erosion, seasonal wetness, soil compaction, soil tilth
Management measures:
• Conservation tillage and crop rotations that include small grain help to prevent excessive soil loss.
• Grassed waterways, water- and sediment-control basins, diversions, and grade-stabilization structures help to prevent gully erosion.
• Subsurface drains can reduce the wetness of the Conover soil if a suitable outlet is available.
• Crop residue management, green manure crops, applications of manure, cover crops, conservation tillage, and a cropping sequence that includes grasses and legumes maintain or improve tilth and increase the available water capacity and the organic matter content.
• Minimizing tillage and tilling and harvesting at the proper soil moisture content help to prevent excessive compaction and maintain tilth.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, water infiltration, and permeability.

Pasture
Major management concerns: Compaction, seasonal wetness
Management measures:
• Proper stocking rates, a planned grazing system, and deferred grazing during wet periods help to keep the pasture in good condition.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants.

Woodland
Major management concerns: Equipment limitation
Management measures:
• Skidders should not be used in areas of the Conover soil during wet periods, when ruts form easily.
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.

Buildings
Major management concerns: Seasonal wetness, shrink-swell
Management measures:
• Constructing buildings on well compacted fill material raises the site a sufficient distance above the water table.
• Wetness can be reduced by installing a drainage system around structures with basements and crawl spaces.
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.

Septic tank absorption fields
Major management concerns: Seasonal wetness, restricted permeability
Management measures:
• Filling or mounding with suitable material helps to raise the absorption field above the water table.
• Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.

Interpretive Groups

Land capability classification: Williamstown—IIe; Conover—IIw
Woodland ordination symbol: Williamstown—5A; Conover—3W
Michigan soil management group: Williamstown—2.5a; Conover—2.5b

12C2—Miami loam, 6 to 12 percent slopes, eroded

Setting

Landform: End moraines, ground moraines
Position on the landform: Knolls and foot slopes
Distinctive landscape features: Eroded surface
Shape of areas: Irregular
Size of areas: 3 to 500 acres

Typical Profile

Surface layer:
0 to 6 inches—dark brown loam

Subsoil:
6 to 24 inches—dark yellowish brown, firm clay loam
24 to 38 inches—yellowish brown, firm loam

Substratum:
38 to 60 inches—yellowish brown loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately slow

Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Medium
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Moderate
Hazard of wind erosion: Slight
Shrink-swell potential: Moderate

Composition

Miami soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
- The very poorly drained Wolcott soils in depressions
- The somewhat poorly drained Conover soils in drainageways and on foot slopes
- The excessively drained, sandy Coloma soils in landscape positions similar to those of the Miami soil

Similar inclusions:
- Areas that are moderately well drained
- Areas that are not eroded
- Soils that have a surface layer of sandy loam

Use and Management

Land use: Dominant uses—cropland, pasture; other uses—woodland, building sites

Cropland
Major management concerns: Water erosion, soil compaction, soil tilth, nutrient loss
Management measures:
- Crop rotations that include grasses or legumes, conservation tillage, and cover crops help to control water erosion.
- Grassed waterways, water- and sediment-control basins, diversions, and grade-stabilization structures help to prevent gully erosion.
- Contour farming, contour stripcropping, and terraces reduce the runoff rate and help to control water erosion.
- Conservation tillage systems, contour farming, cover crops, and sod-based rotations minimize the detachment and loss of nutrients associated with sediment, thus minimizing the losses of solid-phase nitrogen and phosphorus.
- Crop residue management, green manure crops, applications of manure, cover crops, conservation tillage, and a cropping sequence that includes grasses and legumes maintain or improve tilth and increase the available water capacity and the organic matter content.
- Minimizing tillage and tilling and harvesting at the proper soil moisture content help to prevent excessive compaction and maintain tilth.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, water infiltration, and permeability.

Pasture
Major management concerns: Overgrazing
Management measures:
- Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.
- Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: None

Buildings
Major management concerns: Slope, shrink-swell
Management measures:
- Some land grading may be needed.
- Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.

Septic tank absorption fields
Major management concerns: Slope, restricted permeability
Management measures:
- Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly.
- Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.

Interpretive Groups

Land capability classification: IIIe
Woodland ordination symbol: 4A
Michigan soil management group: 2.5a

12D2—Miami clay loam, 12 to 18 percent slopes, eroded

Setting

Landform: End moraines
Position on the landform: Back slopes
Distinctive landscape features: Eroded surface
Shape of areas: Irregular
Size of areas: 3 to 160 acres

Typical Profile

Surface layer:
0 to 6 inches—dark brown clay loam
Subsoil:
6 to 24 inches—dark yellowish brown, firm clay loam
24 to 38 inches—yellowish brown, firm loam

Substratum:
38 to 60 inches—yellowish brown loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately slow
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Rapid
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Severe
Hazard of wind erosion: Slight
Shrink-swell potential: Moderate

Composition

Miami soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
- The very poorly drained Wolcott soils in depressions
- The somewhat poorly drained Conover soils in drainageways and on foot slopes
- The excessively drained, sandy Coloma soils in landscape positions similar to those of the Miami soil

Similar inclusions:
- Areas that are severely eroded
- Areas that are not eroded
- Soils that have a surface layer of sandy loam

Use and Management

Land use: Dominant use—pasture; other uses—cropland, woodland, building sites

Cropland
Major management concerns: Water erosion, soil compaction, soil tilth, nutrient loss
Management measures:
- Crop rotations that include grasses or legumes, conservation tillage, and cover crops help to control water erosion.
- Grassed waterways, water- and sediment-control basins, diversions, and grade-stabilization structures help to prevent gully erosion.
- Contour farming, contour stripcropping, and terraces reduce the runoff rate and help to control water erosion.
- Growing grasses and legumes for pasture or hay is effective in controlling erosion.
- Conservation tillage systems, contour farming, cover crops, and sod-based rotations minimize the detachment and loss of nutrients associated with sediment, thus minimizing the losses of solid-phase nitrogen and phosphorus.
- Crop residue management, green manure crops, applications of manure, cover crops, conservation tillage, and a cropping sequence that includes grasses and legumes maintain or improve tilth and increase the available water capacity and the organic matter content.
- Minimizing tillage and tilling and harvesting at the proper soil moisture content help to prevent excessive compaction and maintain tilth.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, water infiltration, and permeability.

Pasture
Major management concerns: Overgrazing
Management measures:
- Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.
- Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: None

Buildings
Major management concerns: Slope, shrink-swell
Management measures:
- Buildings should be designed so that they conform to the natural slope of the land. Land shaping is necessary in some areas.
- Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.

Septic tank absorption fields
Major management concerns: Slope, restricted permeability
Management measures:
- Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.
- Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.

Interpretive Groups

Land capability classification: IVe
Woodland ordination symbol: 4A
Michigan soil management group: 2.5a

12E—Miami loam, 18 to 35 percent slopes

Setting

Landform: End moraines
Position on the landform: Shoulder slopes and ridges
Shape of areas: Linear

Size of areas: 3 to 80 acres

Typical Profile

Surface layer:
0 to 6 inches—dark brown loam

Subsoil:
6 to 24 inches—dark yellowish brown, firm clay loam
24 to 38 inches—yellowish brown, firm loam

Substratum:
38 to 60 inches—yellowish brown loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately slow
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Very rapid
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Severe
Hazard of wind erosion: Slight
Shrink-swell potential: Moderate

Composition

Miami soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
- The very poorly drained Wolcott soils in depressions
- The very poorly drained Sloan soils on narrow flood plains
- The excessively drained, sandy Coloma soils in landscape positions similar to those of the Miami soil

Similar inclusions:
- Areas that are eroded
- Soils that have a surface layer of sandy loam

Use and Management

Land use: Dominant uses—woodland, pasture; other use—recreation

Cropland
Major management concerns: Slope
Management measures:
- Because of the slope, this soil is very difficult to manage and is generally not used for cultivated crops.

Pasture
Major management concerns: Water erosion, overgrazing
Management measures:
- Growing grasses and legumes for pasture or hay is effective in controlling erosion.
- Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

Woodland
Major management concerns: Equipment limitations, erosion hazard
Management measures:
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
- Seeding skid roads, logging roads, and landings after the trees are logged helps to control erosion.
- Areas sensitive to erosion, esthetics, and drought conditions may require mulch, such as straw, bark, or wood chips.

Buildings
Major management concerns: Slope, shrink-swell
Management measures:
- Because of the slope, this soil is poorly suited to building site development unless extensive land shaping is applied.
- Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.

Septic tank absorption fields
Major management concerns: Slope
Management measures:
- Because of the slope, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: VIe
Woodland ordination symbol: 4R
Michigan soil management group: 2.5a

13B—Conover loam, 1 to 4 percent slopes

Setting

Landform: End moraines, ground moraines
Position on the landform: Foot slopes and low flat areas
Shape of areas: Irregular
Size of areas: 5 to 500 acres

Typical Profile

Surface layer:
0 to 9 inches—very dark gray loam

Subsoil:
9 to 22 inches—dark brown, mottled, firm clay loam
22 to 27 inches—brown, mottled, firm clay loam

Substratum:
27 to 60 inches—brown, mottled loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately slow
Available water capacity: Moderate
Drainage class: Somewhat poorly drained
Seasonal high water table: At a depth of 1 to 2 feet from November through May
Surface runoff: Slow
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Slight
Hazard of wind erosion: Slight
Shrink-swell potential: Moderate

Composition

Conover soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
- The very poorly drained Wolcott soils in depressions
- The very poorly drained Sloan soils on narrow flood plains
- The moderately well drained Williamstown soils in the slightly higher landscape positions

Similar inclusions:
- Soils that have a surface layer of sandy loam

Use and Management

Land use: Dominant use—cropland; other uses—pasture, woodland, building sites

Cropland
Major management concerns: Seasonal wetness, soil compaction, soil tilth
Management measures:
- Most climatically adapted crops can be grown if an adequate drainage system is installed.
- Subsurface drains can reduce the wetness if a suitable outlet is available.
- Crop residue management, green manure crops, applications of manure, cover crops, conservation tillage, and a cropping sequence that includes grasses and legumes maintain or improve tilth and increase the available water capacity and the organic matter content.
- Minimizing tillage and tilling and harvesting at the proper soil moisture content help to prevent excessive compaction and maintain tilth.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, water infiltration, and permeability.

Pasture
Major management concerns: Compaction, seasonal wetness
Management measures:
- Proper stocking rates, a planned grazing system, and deferred grazing during wet periods help to keep the pasture in good condition.
- Restricted grazing during wet periods helps to prevent compaction and poor tilth.
- Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants.

Woodland
Major management concerns: Equipment limitations
Management measures:
- Skidders should not be used during wet periods, when ruts form easily.
- The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.

Buildings
Major management concerns: Seasonal wetness, shrink-swell
Management measures:
- Constructing buildings on well compacted fill material raises the site a sufficient distance above the water table.
- Wetness can be reduced by installing a drainage system around structures with basements and crawl spaces.
- Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.

Septic tank absorption fields
Major management concerns: Seasonal wetness, restricted permeability
Management measures:
- Filling or mounding with suitable material helps to raise the absorption field above the water table.
- Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 3W
Michigan soil management group: 2.5b

14—Wolcott silt loam

Setting

Landform: Ground moraines
Position on the landform: Depressions
Shape of areas: Oval, linear
Size of areas: 5 to 120 acres

Typical Profile

Surface layer:
0 to 10 inches—very dark grayish brown silt loam
Subsurface layer:
10 to 20 inches—very dark gray silty clay loam
Subsoil:
20 to 32 inches—gray, mottled, very firm clay loam
32 to 38 inches—dark yellowish brown, mottled clay loam
Substratum:
38 to 60 inches—dark yellowish brown, mottled loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate
Available water capacity: High
Drainage class: Very poorly drained
Seasonal high water table: 0.5 foot above to 1.0 foot below the surface from December through May
Surface runoff: Very slow or ponded
Flooding: None
Organic matter content: High
Hazard of water erosion: Slight
Hazard of wind erosion: Slight
Shrink-swell potential: Moderate

Composition

Wolcott soil and similar soils: 95 to 100 percent
Contrasting inclusions: 0 to 5 percent

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Conover soils in the slightly higher landscape positions
• The very poorly drained Sloan soils on narrow flood plains
• The very poorly drained Houghton soils in landscape positions similar to those of the Wolcott soil

Similar inclusions:
• Soils that have a surface layer of sandy loam
• Soils that have a mucky surface layer
• Soils that have a subsoil of silty clay loam

Use and Management

Land use: Dominant uses—woodland, wildlife habitat (fig. 5); other uses—cropland, pasture

Cropland
Major management concerns: Seasonal wetness, ponding, soil compaction, soil tilth
Management measures:
• Most climatically adapted crops can be grown if an adequate drainage system is installed.
• Improving drainage is difficult because most areas have poor outlets.
• Crop residue management, green manure crops, applications of manure, cover crops, conservation tillage, and a cropping sequence that includes grasses and legumes maintain or improve tilth and increase the available water capacity and the organic matter content.
• Minimizing tillage and tilling and harvesting at the proper soil moisture content help to prevent excessive compaction and maintain tilth.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, water infiltration, and permeability.

Pasture
Major management concerns: Compaction, seasonal wetness
Management measures:
• Proper stocking rates, a planned grazing system, and deferred grazing during wet periods help to keep the pasture in good condition.
• Hay and pasture plants that can withstand periodic inundation and seasonal wetness should be seeded.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants.

Woodland
Major management concerns: Equipment limitations, seedling mortality, windthrow hazard
Management measures:
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Skidders should not be used during wet periods, when ruts form easily.
• Because of wetness, severe seedling mortality, and plant competition, trees are generally not planted on this soil.
• Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by such harvest methods as selective cutting and strip cutting.

Buildings
Major management concerns: Ponding
Management measures:
• An alternative site should be selected.

Septic tank absorption fields
Major management concerns: Ponding
Management measures:
• Because of ponding, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: IIw

Figure 5.—Native wetland vegetation in an area of Wolcott silt loam. This soil provides good habitat for wetland wildlife.

Woodland ordination symbol: None
Michigan soil management group: 2.5c

15B—Boyer loamy sand, 1 to 6 percent slopes

Setting

Landform: Outwash plains, river terraces
Position on the landform: Broad plains and low knolls
Shape of areas: Irregular
Size of areas: 5 to 800 acres

Typical Profile

Surface layer:
0 to 11 inches—dark brown loamy sand

Subsurface layer:
11 to 16 inches—dark yellowish brown gravelly loamy sand

Subsoil:
16 to 23 inches—brown and dark brown, friable gravelly sandy loam
23 to 30 inches—strong brown, very friable loamy sand

Substratum:
30 to 33 inches—brown coarse sand
33 to 60 inches—dark yellowish brown very gravelly coarse sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid in the upper part, very rapid in the lower part
Available water capacity: Low

Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Very slow
Flooding: None
Organic matter content: Low
Hazard of water erosion: Slight
Hazard of wind erosion: Moderate
Shrink-swell potential: Low

Composition

Boyer soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Matherton soils in drainageways and on foot slopes
• The well drained Hillsdale and Riddles soils, which have more clay in the substratum than the Boyer soil; in landscape positions similar to those of the Boyer soil
• Soils that have a substratum of sand and gravel above a depth of 24 inches

Similar inclusions:
• Soils that have a substratum of sand and gravel below a depth of 40 inches
• Soils that have a surface layer of sandy loam
• Areas that are moderately well drained
• Soils that have slightly brighter colors in the surface layer; in eroded areas

Use and Management

Land use: Dominant use—cropland; other uses—pasture, woodland, building sites

Cropland
Major management concerns: Low available water capacity, wind erosion, low organic matter content, nutrient loss
Management measures:
• Conservation tillage and cover crops help to control wind erosion.
• Timing fertilizer applications so that they meet crop nutrient needs, using split fertilizer applications, and applying fertilizer in bands may reduce the risk of nutrient leaching.
• Increasing the organic matter content in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and may reduce the risk of ground-water pollution.
• Managing irrigation water reduces the amount of nitrogen leached from irrigated fields.
• Using a system of conservation tillage, leaving crop residue on the surface, and adding other organic material conserve moisture.
• Drought-tolerant crops should be selected for planting, or the soil should be irrigated.
• Keeping crop residue on the surface, regularly adding other organic material, and applying a system of no-till planting increase the organic matter content.

Pasture
Major management concerns: Low available water capacity, overgrazing
Management measures:
• Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: None

Buildings
Major management concerns: Cutbanks cave
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields
Major management concerns: Poor filter
Management measures:
• The poor filtering capacity of this soil can result in the pollution of ground water.

Interpretive Groups

Land capability classification: IIIs
Woodland ordination symbol: 4A
Michigan soil management group: 4a

15C—Boyer loamy sand, 6 to 12 percent slopes

Setting

Landform: Outwash plains, river terraces
Position on the landform: Knolls and foot slopes
Shape of areas: Irregular
Size of areas: 5 to 300 acres

Typical Profile

Surface layer:
0 to 11 inches—dark brown loamy sand

Subsurface layer:
11 to 16 inches—dark yellowish brown gravelly loamy sand

Subsoil:
16 to 23 inches—brown and dark brown, friable gravelly sandy loam
23 to 30 inches—strong brown, very friable loamy sand

Substratum:
30 to 33 inches—brown coarse sand

33 to 60 inches—dark yellowish brown very gravelly coarse sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid in the upper part, very rapid in the lower part
Available water capacity: Low
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Slow
Flooding: None
Organic matter content: Low
Hazard of water erosion: Moderate
Hazard of wind erosion: Moderate
Shrink-swell potential: Low

Composition

Boyer soil and similar soils: 85 to 90 percent
Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:
• The poorly drained Gilford soils in depressions
• The well drained Hillsdale and Riddles soils, which have more clay in the substratum than the Boyer soil; in landscape positions similar to those of the Boyer soil

Similar inclusions:
• Soils that have a substratum of sand and gravel below a depth of 40 inches
• Soils that have a surface layer of sandy loam
• Areas that are eroded

Use and Management

Land use: Dominant uses—cropland, pasture; other uses—woodland, building sites

Cropland
Major management concerns: Low available water capacity, water erosion, wind erosion, low organic matter content, nutrient loss
Management measures:
• Crop rotations that include small grain and a system of conservation tillage help to prevent excessive soil loss.
• Grassed waterways, water- and sediment-control basins, diversions, and grade-stabilization structures help to prevent gully erosion.
• Properly regulating the application of irrigation water helps to control runoff and water erosion.
• Conservation tillage and cover crops help to control wind erosion.
• Timing fertilizer applications so that they meet crop nutrient needs, using split fertilizer applications, and applying fertilizer in bands may reduce the risk of nutrient leaching.
• Increasing the organic matter content in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and may reduce the risk of ground-water pollution.
• Using a system of conservation tillage, leaving crop residue on the surface, and adding other organic material conserve moisture.
• Drought-tolerant crops should be selected for planting.
• Keeping crop residue on the surface, regularly adding other organic material, and applying a system of no-till planting increase the organic matter content.

Pasture
Major management concerns: Low available water capacity, overgrazing
Management measures:
• Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: None

Buildings
Major management concerns: Slope, cutbanks cave
Management measures:
• Some land grading may be needed.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields
Major management concerns: Slope, poor filter
Management measures:
• Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly.
• The poor filtering capacity of this soil can result in the pollution of ground water.

Interpretive Groups

Land capability classification: IIIe
Woodland ordination symbol: 4A
Michigan soil management group: 4a

15D2—Boyer gravelly loamy sand, 12 to 18 percent slopes, eroded

Setting

Landform: Outwash plains, river terraces
Position on the landform: Back slopes
Distinctive landscape features: Eroded surface
Shape of areas: Irregular, oval
Size of areas: 5 to 200 acres

Typical Profile

Surface layer:
0 to 5 inches—dark brown gravelly loamy sand
Subsurface layer:
5 to 10 inches—dark yellowish brown gravelly loamy sand
Subsoil:
10 to 19 inches—brown and dark brown, friable gravelly sandy loam
19 to 24 inches—strong brown, very friable loamy sand
Substratum:
24 to 29 inches—brown coarse sand
29 to 60 inches—dark yellowish brown very gravelly coarse sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid in the upper part, very rapid in the lower part
Available water capacity: Low
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Medium
Flooding: None
Organic matter content: Low
Hazard of water erosion: Moderate
Hazard of wind erosion: Moderate
Shrink-swell potential: Low

Composition

Boyer soil and similar soils: 85 to 90 percent
Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:
• The poorly drained Gilford soils in depressions
• The well drained Hillsdale and Riddles soils, which have more clay in the substratum than the Boyer soil; in landscape positions similar to those of the Boyer soil
Similar inclusions:
• Soils that have a substratum of sand and gravel below a depth of 40 inches
• Soils that have a surface layer of sandy loam
• Areas that are not eroded

Use and Management

Land use: Dominant use—pasture; other uses—cropland, woodland, building sites

Cropland
Major management concerns: Low available water capacity, water erosion, wind erosion, low organic matter content, nutrient loss
Management measures:
• Crop rotations that include grasses or legumes, conservation tillage, and cover crops help to control water erosion.
• Grassed waterways, water- and sediment-control basins, diversions, and grade-stabilization structures help to prevent gully erosion.
• Growing grasses and legumes for pasture or hay is effective in controlling erosion.
• Conservation tillage and cover crops help to control wind erosion.
• Timing fertilizer applications so that they meet crop nutrient needs, using split fertilizer applications, and applying fertilizer in bands may reduce the risk of nutrient leaching.
• Increasing the organic matter content in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and may reduce the risk of ground-water pollution.
• Conservation tillage systems, contour farming, cover crops, and sod-based rotations minimize the detachment and loss of nutrients associated with sediment, thus minimizing the losses of solid-phase nitrogen and phosphorus.
• Using a system of conservation tillage, leaving crop residue on the surface, and adding other organic material conserve moisture.
• Drought-tolerant crops should be selected for planting.
• Keeping crop residue on the surface, regularly adding other organic material, and applying a system of no-till planting increase the organic matter content.

Pasture
Major management concerns: Low available water capacity, overgrazing
Management measures:
• Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: None

Buildings
Major management concerns: Slope, cutbanks cave
Management measures:
• Buildings should be designed so that they conform to the natural slope of the land. Land shaping is necessary in some areas.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields
Major management concerns: Slope, poor filter
Management measures:
• Land shaping, pressurizing the absorption field, and

installing the distribution lines on the contour help to overcome the slope.
• The poor filtering capacity of this soil can result in the pollution of ground water.

Interpretive Groups

Land capability classification: IVe
Woodland ordination symbol: 4A
Michigan soil management group: 4a

15E—Boyer gravelly loamy sand, 18 to 35 percent slopes

Setting

Landform: Outwash plains, river terraces
Position on the landform: Shoulder slopes and ridges
Shape of areas: Linear, oval
Size of areas: 5 to 80 acres

Typical Profile

Surface layer:
0 to 7 inches—dark brown gravelly loamy sand

Subsurface layer:
7 to 16 inches—dark yellowish brown gravelly loamy sand

Subsoil:
16 to 19 inches—brown and dark brown, friable gravelly sandy loam
19 to 23 inches—strong brown, very friable loamy sand

Substratum:
23 to 29 inches—brown coarse sand
29 to 60 inches—dark yellowish brown very gravelly coarse sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid in the upper part, very rapid in the lower part
Available water capacity: Low
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Rapid
Flooding: None
Organic matter content: Low
Hazard of water erosion: Severe
Hazard of wind erosion: Moderate
Shrink-swell potential: Low

Composition

Boyer soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The poorly drained Gilford soils in depressions
• The well drained Miami, Hillsdale, and Riddles soils, which have more clay in the substratum than the Boyer soil; in landscape positions similar to those of the Boyer soil

Similar inclusions:
• Soils that have a substratum of sand and gravel below a depth of 40 inches
• Soils that have a surface layer of sandy loam
• Areas that are eroded

Use and Management

Land use: Dominant uses—pasture, woodland; other use—recreation

Cropland
Major management concerns: Slope
Management measures:
• Because of the slope, this soil is very difficult to manage and is generally not used for cultivated crops.

Pasture
Major management concerns: Low available water capacity, overgrazing
Management measures:
• Growing grasses and legumes for pasture or hay is effective in controlling erosion.
• Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: Equipment limitations, erosion hazard
Management measures:
• Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
• Seeding skid roads, logging roads, and landings after the trees are logged helps to control erosion.
• Areas sensitive to erosion, esthetics, and drought conditions may require mulch, such as straw, bark, or wood chips.

Buildings
Major management concerns: Slope
Management measures:
• Because of the slope, this soil is poorly suited to building site development unless extensive land shaping is applied.

Septic tank absorption fields
Major management concerns: Slope
Management measures:
• Because of the slope, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: VIe
Woodland ordination symbol: 4R
Michigan soil management group: 4a

16B—Fox sandy loam, 1 to 6 percent slopes

Setting

Landform: Outwash plains, stream terraces
Position on the landform: Broad plains and low knolls
Shape of areas: Irregular
Size of areas: 5 to 600 acres

Typical Profile

Surface layer:
0 to 8 inches—dark brown sandy loam

Subsurface layer:
8 to 11 inches—dark brown sandy loam

Subsoil:
11 to 24 inches—dark brown, friable sandy loam and gravelly sandy loam
24 to 34 inches—dark brown, firm gravelly sandy clay loam
34 to 38 inches—dark yellowish brown, loose sand and gravel

Substratum:
38 to 60 inches—brown sand and gravel

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate in the upper part, rapid in the lower part
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Slow
Flooding: None
Organic matter content: Moderately low or low
Hazard of water erosion: Slight
Hazard of wind erosion: Moderate
Shrink-swell potential: Moderate

Composition

Fox soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Matherton soils in drainageways and on foot slopes
• The well drained Hillsdale and Riddles soils, which have more clay in the substratum than the Fox soil; in landscape positions similar to those of the Fox soil

Similar inclusions:
• Soils that have a substratum of sand and gravel below a depth of 40 inches
• Soils that have a surface layer of loamy sand
• Soils that are moderately well drained

Use and Management

Land use: Dominant use—cropland; other uses—pasture, woodland, building sites

Cropland
Major management concerns: Wind erosion, water erosion, nutrient loss
Management measures:
• Crop rotations that include grasses and legumes and small grain help to control runoff and water erosion.
• Properly regulating the application of irrigation water helps to control runoff and water erosion.
• Conservation tillage and crop residue management help to control wind erosion.
• Timing fertilizer applications so that they meet crop nutrient needs, using split fertilizer applications, and applying fertilizer in bands may reduce the risk of nutrient leaching.
• Including grasses and legumes in the rotation minimizes nutrient losses, improves soil structure, and provides nitrogen for subsequent crops.
• Managing irrigation water reduces the amount of nitrogen leached from irrigated fields.
• Using a system of conservation tillage, leaving crop residue on the surface, and adding other organic material conserve moisture.

Pasture
Major management concerns: Overgrazing
Management measures:
• Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: None

Buildings
Major management concerns: Shrink-swell, cutbanks cave

Management measures:
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields
Major management concerns: Poor filter
Management measures:
• The poor filtering capacity of this soil can result in the pollution of ground water.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 4A
Michigan soil management group: 3/5a

16C2—Fox sandy loam, 6 to 12 percent slopes, eroded

Setting

Landform: Outwash plains, stream terraces
Position on the landform: Knolls and foot slopes
Distinctive landscape features: Eroded surface
Shape of areas: Irregular
Size of areas: 5 to 160 acres

Typical Profile

Surface layer:
0 to 8 inches—dark brown sandy loam

Subsurface layer:
8 to 11 inches—dark brown sandy loam

Subsoil:
11 to 24 inches—dark brown, friable sandy loam and gravelly sandy loam
24 to 34 inches—dark brown, firm gravelly sandy clay loam
34 to 38 inches—dark yellowish brown, loose sand and gravel

Substratum:
38 to 60 inches—brown sand and gravel

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate in the upper part, rapid in the lower part
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Medium
Flooding: None
Organic matter content: Moderately low or low
Hazard of water erosion: Moderate
Hazard of wind erosion: Moderate
Shrink-swell potential: Moderate

Composition

Fox soil and similar soils: 85 to 90 percent
Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Matherton soils in drainageways and on foot slopes
• The well drained Hillsdale and Riddles soils, which have more clay in the substratum than the Fox soil; in landscape positions similar to those of the Fox soil

Similar inclusions:
• Soils that have a substratum of sand and gravel below a depth of 40 inches
• Soils that have a surface layer of loamy sand
• Areas that are not eroded

Use and Management

Land use: Dominant uses—cropland, pasture; other uses—woodland, building sites

Cropland
Major management concerns: Water erosion, wind erosion, nutrient loss
Management measures:
• Conservation tillage and crop rotations that include small grain help to prevent excessive soil loss.
• Grassed waterways, water- and sediment-control basins, diversions, and grade-stabilization structures help to prevent gully erosion.
• Contour farming, contour stripcropping, and terraces reduce the runoff rate and help to control water erosion.
• Properly regulating the application of irrigation water helps to control runoff and water erosion.
• Conservation tillage and crop residue management help to control wind erosion.
• Timing fertilizer applications so that they meet crop nutrient needs, using split fertilizer applications, and applying fertilizer in bands may reduce the risk of nutrient leaching.
• Including grasses and legumes in the rotation minimizes nutrient losses, improves soil structure, and provides nitrogen for subsequent crops.
• Conservation tillage systems, contour farming, cover crops, and sod-based rotations minimize the detachment and loss of nutrients associated with sediment, thus minimizing the losses of solid-phase nitrogen and phosphorus.
• Using a system of conservation tillage, leaving crop residue on the surface, and adding other organic material conserve moisture.

Pasture
Major management concerns: Overgrazing
Management measures:
• Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: None

Buildings
Major management concerns: Slope, shrink-swell, cutbanks cave
Management measures:
• Some land grading may be needed.
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields
Major management concerns: Slope, poor filter
Management measures:
• Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly.
• The poor filtering capacity of this soil can result in the pollution of ground water.

Interpretive Groups

Land capability classification: IIIe
Woodland ordination symbol: 4A
Michigan soil management group: 3/5a

16D2—Fox gravelly sandy loam, 12 to 18 percent slopes, eroded

Setting

Landform: Outwash plains, stream terraces
Position on the landform: Back slopes
Distinctive landscape features: Eroded surface
Shape of areas: Irregular, oval
Size of areas: 5 to 120 acres

Typical Profile

Surface layer:
0 to 8 inches—dark brown gravelly sandy loam
Subsoil:
8 to 23 inches—dark brown, friable gravelly sandy loam
23 to 34 inches—dark brown, firm gravelly sandy clay loam
34 to 37 inches—dark yellowish brown, loose sand and gravel
Substratum:
37 to 60 inches—brown sand and gravel

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate in the upper part, rapid in the lower part
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Medium
Flooding: None
Organic matter content: Moderately low or low
Hazard of water erosion: Severe
Hazard of wind erosion: Moderate
Shrink-swell potential: Moderate

Composition

Fox soil and similar soils: 85 to 90 percent
Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:
• The poorly drained Sebewa soils in depressions
• The well drained Hillsdale and Riddles soils, which have more clay in the substratum than the Fox soil; in landscape positions similar to those of the Fox soil
Similar inclusions:
• Soils that have a substratum of sand and gravel below a depth of 40 inches
• Soils that have a surface layer of loamy sand
• Areas that are not eroded

Use and Management

Land use: Dominant use—pasture; other uses—cropland, woodland, building sites

Cropland
Major management concerns: Water erosion, wind erosion, nutrient loss
Management measures:
• Crop rotations that include grasses or legumes, conservation tillage, and cover crops help to control water erosion.
• Grassed waterways, water- and sediment-control basins, diversions, and grade-stabilization structures help to prevent gully erosion.
• Contour farming, contour stripcropping, and terraces reduce the runoff rate and help to control water erosion.
• Growing grasses and legumes for pasture or hay is effective in controlling erosion.
• Conservation tillage and crop residue management help to control wind erosion.
• Timing fertilizer applications so that they meet crop

nutrient needs, using split fertilizer applications, and applying fertilizer in bands may reduce the risk of nutrient leaching.
• Including grasses and legumes in the rotation minimizes nutrient losses, improves soil structure, and provides nitrogen for subsequent crops.
• Conservation tillage systems, contour farming, cover crops, and sod-based rotations minimize the detachment and loss of nutrients associated with sediment, thus minimizing the losses of solid-phase nitrogen and phosphorus.
• Using a system of conservation tillage, leaving crop residue on the surface, and adding other organic material conserve moisture.

Pasture
Major management concerns: Overgrazing
Management measures:
• Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: None

Buildings
Major management concerns: Slope, shrink-swell, cutbanks cave
Management measures:
• Buildings should be designed so that they conform to the natural slope of the land. Land shaping is necessary in some areas.
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields
Major management concerns: Slope, poor filter
Management measures:
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.
• The poor filtering capacity of this soil can result in the pollution of ground water.

Interpretive Groups

Land capability classification: IVe
Woodland ordination symbol: 4A
Michigan soil management group: 3/5a

16E—Fox gravelly sandy loam, 18 to 35 percent slopes

Setting

Landform: Outwash plains, stream terraces
Position on the landform: Shoulder slopes and ridges
Shape of areas: Linear, oval
Size of areas: 5 to 80 acres

Typical Profile

Surface layer:
0 to 8 inches—dark brown gravelly sandy loam

Subsurface layer:
8 to 11 inches—dark brown sandy loam

Subsoil:
11 to 24 inches—dark brown, friable gravelly sandy loam
24 to 34 inches—dark brown, firm gravelly sandy clay loam
34 to 38 inches—dark yellowish brown, loose sand and gravel

Substratum:
38 to 60 inches—brown sand and gravel

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate in the upper part, rapid in the lower part
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Rapid
Flooding: None
Organic matter content: Moderately low or low
Hazard of water erosion: Severe
Hazard of wind erosion: Moderate
Shrink-swell potential: Moderate

Composition

Fox soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The poorly drained Sebewa soils in depressions
• The well drained Hillsdale and Riddles soils, which have more clay in the substratum than the Fox soil; in landscape positions similar to those of the Fox soil

Similar inclusions:
• Soils that have a substratum of sand and gravel below a depth of 40 inches
• Soils that have a surface layer of loamy sand
• Areas that are eroded

Use and Management

Land use: Dominant uses—pasture, woodland; other uses—recreation, wildlife

Cropland

Major management concerns: Slope
Management measures:
• Because of the slope, this soil is very difficult to manage and is generally not used for cultivated crops.

Pasture

Major management concerns: Overgrazing
Management measures:
• Growing grasses and legumes for pasture or hay is effective in controlling erosion.
• Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Equipment limitations
Management measures:
• Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
• Seeding skid roads, logging roads, and landings after the trees are logged helps to control erosion.
• Areas sensitive to erosion, esthetics, and drought conditions may require mulch, such as straw, bark, or wood chips.

Buildings

Major management concerns: Slope
Management measures:
• Because of the slope, this soil is poorly suited to building site development unless extensive land shaping is applied.

Septic tank absorption fields

Major management concerns: Slope
Management measures:
• Because of the slope, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: VIe
Woodland ordination symbol: 4R
Michigan soil management group: 3/5a

17—Sebewa loam

Setting

Landform: Outwash plains
Position on the landform: Depressions
Shape of areas: Oval, linear
Size of areas: 5 to 500 acres

Typical Profile

Surface layer:
0 to 11 inches—very dark gray loam
Subsoil:
11 to 23 inches—grayish brown, mottled, firm clay loam
Substratum:
23 to 34 inches—light brownish gray, mottled, stratified sand and loamy sand
34 to 60 inches—grayish brown, mottled gravelly coarse sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate in the upper part, rapid in the lower part
Available water capacity: Low
Drainage class: Poorly drained
Seasonal high water table: 1 foot above to 1 foot below the surface from September through May
Surface runoff: Very slow or ponded
Flooding: None
Organic matter content: High
Hazard of water erosion: Slight
Hazard of wind erosion: Slight
Shrink-swell potential: Moderate

Composition

Sebewa soil and similar soils: 95 to 100 percent
Contrasting inclusions: 0 to 5 percent

Inclusions

Contrasting inclusions:
• The moderately well drained Williamstown soils in the higher landscape positions
• The very poorly drained, organic Houghton soils in landscape positions similar to those of the Sebewa soil
• The somewhat poorly drained Matherton soils in the slightly higher landscape positions

Similar inclusions:
• Soils that have a surface layer of sandy loam
• Soils that have a mucky surface layer

Use and Management

Land use: Dominant use—cropland; other uses—woodland, pasture

Cropland

Major management concerns: Seasonal wetness, ponding, low available water capacity, soil compaction, soil tilth
Management measures:
• Most climatically adapted crops can be grown if an

adequate drainage system is installed.
• Subsurface drains can reduce the wetness if a suitable outlet is available.
• Overdrainage can result in droughtiness.
• Using a system of conservation tillage, leaving crop residue on the surface, and adding other organic material conserve moisture.
• Crop residue management, green manure crops, applications of manure, cover crops, conservation tillage, and a cropping sequence that includes grasses and legumes maintain or improve tilth and increase the available water capacity and the organic matter content.
• Minimizing tillage and tilling and harvesting at the proper soil moisture content help to prevent excessive compaction and maintain tilth.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, water infiltration, and permeability.

Pasture
Major management concerns: Compaction, seasonal wetness
Management measures:
• Proper stocking rates, a planned grazing system, and deferred grazing during wet periods help to keep the pasture in good condition.
• Hay and pasture plants that can withstand periodic inundation and seasonal wetness should be seeded.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants.

Woodland
Major management concerns: Equipment limitations, seedling mortality, windthrow hazard
Management measures:
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Skidders should not be used during wet periods, when ruts form easily.
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
• Because of wetness, severe seedling mortality, and plant competition, trees are generally not planted on this soil.
• Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by such harvest methods as selective cutting and strip cutting.

Buildings
Major management concerns: Ponding, cutbanks cave
Management measures:
• An alternative site should be selected.

Septic tank absorption fields
Major management concerns: Ponding
Management measures:
• Because of ponding, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: IIw
Woodland ordination symbol: 3W
Michigan soil management group: 3/5c

18B—Glynwood-Blount complex, 1 to 6 percent slopes

Setting

Landform: End moraines, ground moraines
Position on the landform: Broad plains and low knolls
Distinctive landscape features: Complex slopes
Shape of areas: Irregular
Size of areas: 5 to 1,900 acres

Typical Profile

Glynwood

Surface layer:
0 to 7 inches—brown clay loam

Subsoil:
7 to 14 inches—dark brown, firm clay loam
14 to 23 inches—dark brown, mottled, firm clay
23 to 26 inches—dark brown, mottled, firm clay loam

Substratum:
26 to 60 inches—grayish brown, mottled clay loam

Blount

Surface layer:
0 to 9 inches—very dark grayish brown silt loam

Subsoil:
9 to 24 inches—brown, mottled, firm silty clay loam
24 to 32 inches—dark yellowish brown, mottled, firm clay loam
32 to 60 inches—dark yellowish brown, mottled, firm clay loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Slow
Available water capacity: Moderate
Drainage class: Glynwood—moderately well drained; Blount—somewhat poorly drained
Seasonal high water table: Glynwood—perched at a

depth of 2.0 to 3.5 feet from January through April; Blount—perched at a depth of 1 to 3 feet from January through May
Surface runoff: Glynwood—medium; Blount—slow
Flooding: None
Organic matter content: Glynwood—moderately low; Blount—moderate
Hazard of water erosion: Glynwood—moderate; Blount—slight
Hazard of wind erosion: Slight
Shrink-swell potential: Moderate

Composition

Glynwood soil and similar soils: 50 to 65 percent
Blount soil and similar soils: 30 to 45 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The very poorly drained Pewamo soils in depressions
• The well drained Steamburg soils in the slightly higher positions on the landscape
Similar inclusions:
• Areas that are eroded
• Soils that have a surface layer of sandy loam
• Areas that are well drained

Use and Management

Land use: Dominant use—cropland; other uses—pasture, woodland, building sites

Cropland
Major management concerns: Water erosion, seasonal wetness, soil compaction, soil tilth
Management measures:
• Conservation tillage and crop rotations that include small grain help to prevent excessive soil loss.
• Grassed waterways, water- and sediment-control basins, diversions, and grade-stabilization structures help to prevent gully erosion.
• Including grasses and legumes in the rotation minimizes nutrient losses, improves soil structure, and provides nitrogen for subsequent crops.
• Subsurface drains can reduce the wetness if a suitable outlet is available.
• Because of the slow permeability, subsurface drains should be narrowly spaced.
• Crop residue management, green manure crops, applications of manure, cover crops, conservation tillage, and a cropping sequence that includes grasses and legumes maintain or improve tilth and increase the available water capacity and the organic matter content.
• Minimizing tillage and tilling and harvesting at the proper soil moisture content help to prevent excessive compaction and maintain tilth.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, water infiltration, and permeability.

Pasture
Major management concerns: Compaction, seasonal wetness
Management measures:
• Proper stocking rates, a planned grazing system, and deferred grazing during wet periods help to keep the pasture in good condition.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants.

Woodland
Major management concerns: Equipment limitations, seedling mortality, windthrow hazard
Management measures:
• Skidders should not be used on the Blount soil during wet periods, when ruts form easily.
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or to midwinter, when the soil is frozen or has an adequate snow cover.
• Because of the very slow permeability and the sticky and plastic subsoil, logging roads should be graveled.
• Windthrow on the Blount soil can be minimized by harvest methods that do not leave the remaining trees widely spaced and by such harvest methods as selective cutting and strip cutting.

Buildings
Major management concerns: Seasonal wetness, shrink-swell
Management measures:
• Constructing buildings on well compacted fill material raises the site a sufficient distance above the water table.
• Wetness can be reduced by installing a drainage system around structures with basements and crawl spaces.
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.

Septic tank absorption fields
Major management concerns: Seasonal wetness, slow permeability
Management measures:
• An alternative site should be selected.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: Glynwood—4C; Blount—3C

Michigan soil management group: Glynwood—1.5b; Blount—1.5b

18C2—Morley loam, 6 to 12 percent slopes, eroded

Setting

Landform: End moraines, ground moraines
Position on the landform: Knolls and foot slopes
Distinctive landscape features: Eroded surface, complex slopes
Shape of areas: Irregular
Size of areas: 3 to 500 acres

Typical Profile

Surface layer:
0 to 6 inches—dark brown loam

Subsoil:
6 to 15 inches—dark yellowish brown, firm clay loam
15 to 31 inches—dark yellowish brown, mottled, firm and very firm clay loam

Substratum:
31 to 60 inches—brown, mottled clay loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Slow
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Rapid
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Severe
Hazard of wind erosion: Slight
Shrink-swell potential: Moderate

Composition

Morley soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
The very poorly drained Pewamo soils in depressions
The somewhat poorly drained Blount soils in drainageways and on foot slopes
The excessively drained, sandy Coloma soils in landscape positions similar to those of the Morley soil

Similar inclusions:
Areas that are moderately well drained
Areas that are not eroded
Soils that have a surface layer of sandy loam

Use and Management

Land use: Dominant uses—cropland, pasture; other uses—woodland, building sites

Cropland

Major management concerns: Water erosion, soil compaction, soil tilth, nutrient loss
Management measures:
- Crop rotations that include grasses or legumes, conservation tillage, and cover crops help to control water erosion.
- Grassed waterways, water- and sediment-control basins, diversions, and grade-stabilization structures help to prevent gully erosion.
- Contour farming, contour stripcropping, and terraces reduce the runoff rate and help to control water erosion.
- Including grasses and legumes in the rotation minimizes nutrient losses, improves soil structure, and provides nitrogen for subsequent crops.
- Conservation tillage systems, contour farming, cover crops, and sod-based rotations minimize the detachment and loss of nutrients associated with sediment, thus minimizing the losses of solid-phase nitrogen and phosphorus.
- Crop residue management, green manure crops, applications of manure, cover crops, conservation tillage, and a cropping sequence that includes grasses and legumes maintain or improve tilth and increase the available water capacity and the organic matter content.
- Minimizing tillage and tilling and harvesting at the proper soil moisture content help to prevent excessive compaction and maintain tilth.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, water infiltration, and permeability.

Pasture

Major management concerns: Overgrazing, water erosion
Management measures:
- Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.
- Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: None

Buildings

Major management concerns: Slope, shrink-swell
Management measures:
- Some land grading may be needed.
- Properly designing and strengthening footings and foundations can help to prevent the structural damage

caused by shrinking and swelling.

Septic tank absorption fields
Major management concerns: Slope, slow permeability
Management measures:
• An alternative site should be selected.

Interpretive Groups

Land capability classification: IIIe
Woodland ordination symbol: 5A
Michigan soil management group: 1.5a

18D2—Morley clay loam, 12 to 18 percent slopes, eroded

Setting

Landform: End moraines
Position on the landform: Back slopes
Distinctive landscape features: Eroded surface, complex slopes
Shape of areas: Irregular
Size of areas: 3 to 300 acres

Typical Profile

Surface layer:
0 to 6 inches—dark brown clay loam
Subsoil:
6 to 15 inches—dark yellowish brown, firm clay loam
15 to 31 inches—dark yellowish brown, mottled, firm and very firm clay loam
Substratum:
31 to 60 inches—brown clay loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Slow
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Rapid
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Severe
Hazard of wind erosion: Slight
Shrink-swell potential: Moderate

Composition

Morley soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The very poorly drained Pewamo soils in depressions
• The excessively drained, sandy Coloma soils in landscape positions similar to those of the Morley soil

Similar inclusions:
• Areas that are severely eroded
• Areas that are not eroded
• Soils that have a surface layer of sandy loam

Use and Management

Land use: Dominant use—pasture; other uses—cropland, woodland, building sites

Cropland
Major management concerns: Water erosion, soil compaction, soil tilth, nutrient loss
Management measures:
• Crop rotations that include grasses or legumes, conservation tillage, and cover crops help to control water erosion.
• Grassed waterways, water- and sediment-control basins, diversions, and grade-stabilization structures help to prevent gully erosion.
• Contour farming, contour stripcropping, and terraces reduce the runoff rate and help to control water erosion.
• Growing grasses and legumes for pasture or hay is effective in controlling erosion.
• Including grasses and legumes in the rotation minimizes nutrient losses, improves soil structure, and provides nitrogen for subsequent crops.
• Conservation tillage systems, contour farming, cover crops, and sod-based rotations minimize the detachment and loss of nutrients associated with sediment, thus minimizing the losses of solid-phase nitrogen and phosphorus.
• Crop residue management, green manure crops, applications of manure, cover crops, conservation tillage, and a cropping sequence that includes grasses and legumes maintain or improve tilth and increase the available water capacity and the organic matter content.
• Minimizing tillage and tilling and harvesting at the proper soil moisture content help to prevent excessive compaction and maintain tilth.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, water infiltration, and permeability.

Pasture
Major management concerns: Overgrazing, water erosion
Management measures:
• Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants.

Woodland
Major management concerns: None

Buildings
Major management concerns: Slope, shrink-swell
Management measures:
• Buildings should be designed so that they conform to the natural slope of the land. Land shaping is necessary in some areas.
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.

Septic tank absorption fields
Major management concerns: Slope, slow permeability
Management measures:
• An alternative site should be selected.

Interpretive Groups

Land capability classification: IVe
Woodland ordination symbol: 5A
Michigan soil management group: 1.5a

18E—Morley loam, 18 to 35 percent slopes

Setting

Landform: End moraines
Position on the landform: Shoulder slopes and ridges
Distinctive landscape features: Complex slopes
Shape of areas: Linear
Size of areas: 3 to 90 acres

Typical Profile

Surface layer:
0 to 6 inches—dark brown loam
Subsoil:
6 to 15 inches—dark yellowish brown, firm clay loam
15 to 31 inches—dark yellowish brown, mottled, firm and very firm clay loam
Substratum:
31 to 60 inches—brown clay loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Slow
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Very rapid
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Severe
Hazard of wind erosion: Slight
Shrink-swell potential: Moderate

Composition

Morley soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The very poorly drained Pewamo soils in depressions
• The very poorly drained Sloan soils on narrow flood plains
• The excessively drained, sandy Coloma soils in landscape positions similar to those of the Morley soil

Similar inclusions:
• Areas that are eroded
• Soils that have a surface layer of sandy loam

Use and Management

Land use: Dominant use—pasture; other uses—woodland, recreation, wildlife habitat

Cropland
Major management concerns: Slope
Management measures:
• Because of the slope, this soil is very difficult to manage and is generally not used for cultivated crops.

Pasture
Major management concerns: Overgrazing, water erosion
Management measures:
• Growing grasses and legumes for pasture or hay is effective in controlling erosion.
• Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants.

Woodland
Major management concerns: Equipment limitations, slope
Management measures:
• Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
• Seeding skid roads, logging roads, and landings after the trees are logged helps to control erosion.
• Areas sensitive to erosion, esthetics, and drought conditions may require mulch, such as straw, bark, or wood chips.

Buildings
Major management concerns: Slope
Management measures:
• An alternative site should be selected.

Septic tank absorption fields
Major management concerns: Slope
Management measures:
• Because of the slope, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: VIe
Woodland ordination symbol: 5R
Michigan soil management group: 1.5a

19B—Blount silt loam, 0 to 4 percent slopes

Setting

Landform: Ground moraines
Position on the landform: Foot slopes and low flat areas
Distinctive landscape features: Complex slopes
Shape of areas: Irregular
Size of areas: 5 to 1,200 acres

Typical Profile

Surface layer:
0 to 9 inches—very dark grayish brown silt loam
Subsoil:
9 to 24 inches—brown, mottled, firm silty clay loam
24 to 32 inches—dark yellowish brown, mottled, firm clay loam
32 to 60 inches—dark yellowish brown, mottled, firm clay loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Slow
Available water capacity: Moderate
Drainage class: Somewhat poorly drained
Seasonal high water table: Perched at a depth of 1 to 3 feet from January through May
Surface runoff: Slow
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Slight
Hazard of wind erosion: Slight
Shrink-swell potential: Moderate

Composition

Blount soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The very poorly drained Pewamo soils in depressions
• The moderately well drained Glynwood soils in the slightly higher positions on the landscape
Similar inclusions:
• Soils that have a surface layer of sandy loam

Use and Management

Land use: Dominant use—cropland; other uses pasture, woodland, building sites

Cropland
Major management concerns: Water erosion, seasonal wetness, soil compaction, soil tilth
Management measures:
• Conservation tillage and crop rotations that include small grain help to prevent excessive soil loss.
• Grassed waterways, water- and sediment-control basins, diversions, and grade-stabilization structures help to prevent gully erosion.
• Including grasses and legumes in the rotation minimizes nutrient losses, improves soil structure, and provides nitrogen for subsequent crops.
• Most climatically adapted crops can be grown if an adequate drainage system is installed.
• Subsurface drains can reduce the wetness if a suitable outlet is available.
• Because of the slow permeability, subsurface drains should be narrowly spaced.
• Crop residue management, green manure crops, applications of manure, cover crops, conservation tillage, and a cropping sequence that includes grasses and legumes maintain or improve tilth and increase the available water capacity and the organic matter content.
• Minimizing tillage and tilling and harvesting at the proper soil moisture content help to prevent excessive compaction and maintain tilth.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, water infiltration, and permeability.

Pasture
Major management concerns: Compaction, seasonal wetness
Management measures:
• Proper stocking rates, a planned grazing system, and deferred grazing during wet periods help to keep the pasture in good condition.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants.

Woodland
Major management concerns: Equipment limitations, seedling mortality, windthrow hazard
Management measures:
• Skidders should not be used during wet periods, when ruts form easily.
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
• Because of the restricted permeability and the sticky and plastic subsoil, logging roads should be graveled.

• Special site preparation, such as bedding before planting, can reduce the seedling mortality rate.
• Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by such harvest methods as selective cutting and strip cutting.

Buildings
Major management concerns: Seasonal wetness, shrink-swell
Management measures:
• Constructing buildings on well compacted fill material raises the site a sufficient distance above the water table.
• Wetness can be reduced by installing a drainage system around structures with basements and crawl spaces.
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.

Septic tank absorption fields
Major management concerns: Seasonal wetness, slow permeability
Management measures:
• An alternative site should be selected.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 3C
Michigan soil management group: 1.5b

20—Pewamo silt loam

Setting

Landform: End moraines, ground moraines
Position on the landform: Depressions
Shape of areas: Oval, linear
Size of areas: 5 to 150 acres

Typical Profile

Surface layer:
0 to 11 inches—very dark grayish brown silt loam
Subsoil:
11 to 17 inches—grayish brown, mottled, firm clay loam
17 to 48 inches—dark grayish brown, mottled, firm clay loam
Substratum:
48 to 60 inches—gray, mottled clay loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately slow
Available water capacity: High
Drainage class: Poorly drained
Seasonal high water table: 1 foot above to 1 foot below the surface from December through May
Surface runoff: Very slow or ponded
Flooding: None
Organic matter content: High
Hazard of water erosion: Slight
Hazard of wind erosion: Slight
Shrink-swell potential: Moderate

Composition

Pewamo soil and similar soils: 95 to 100 percent
Contrasting inclusions: 0 to 5 percent

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Blount soils in the slightly higher positions on the landscape
• The moderately well drained Glynwood soils on knobs
• The very poorly drained, organic Houghton soils in landscape positions similar to those of the Pewamo soil
Similar inclusions:
• Soils that have a surface layer of sandy loam
• Soils that have a mucky surface layer

Use and Management

Land use: Dominant use—woodland; other uses—cropland, pasture

Cropland
Major management concerns: Seasonal wetness, ponding, soil compaction, soil tilth
Management measures:
• Including grasses and legumes in the rotation minimizes nutrient losses, improves soil structure, and provides nitrogen for subsequent crops.
• Most climatically adapted crops can be grown if an adequate drainage system is installed.
• Improving drainage is difficult because most areas have poor outlets.
• Shallow surface ditches help to remove surface water after heavy rains.
• Because of the restricted permeability, subsurface drains should be narrowly spaced.
• Crop residue management, green manure crops, applications of manure, cover crops, conservation tillage, and a cropping sequence that includes grasses and legumes maintain or improve tilth and increase the available water capacity and the organic matter content.
• Minimizing tillage and tilling and harvesting at the proper soil moisture content help to prevent excessive compaction and maintain tilth.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, water infiltration, and permeability.

Pasture
Major management concerns: Compaction, seasonal wetness
Management measures:
• Proper stocking rates, a planned grazing system, and deferred grazing during wet periods help to keep the pasture in good condition.
• Hay and pasture plants that can withstand periodic inundation and seasonal wetness should be seeded.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants.

Woodland
Major management concerns: Equipment limitations, seedling mortality, windthrow hazard
Management measures:
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Skidders should not be used during wet periods, when ruts form easily.
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
• Because of the restricted permeability and the sticky and plastic subsoil, logging roads should be graveled.
• Because of wetness, severe seedling mortality, and plant competition, trees are generally not planted on this soil.
• Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by such harvest methods as selective cutting and strip cutting.

Buildings
Major management concerns: Ponding
Management measures:
• An alternative site should be selected.

Septic tank absorption fields
Major management concerns: Ponding
Management measures:
• Because of ponding, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: IIw
Woodland ordination symbol: 3W
Michigan soil management group: 1.5c

24B—Spinks loamy sand, 0 to 6 percent slopes

Setting

Landform: Outwash plains, till plains
Position on the landform: Broad plains and low knolls
Shape of areas: Irregular
Size of areas: 3 to 150 acres

Typical Profile

Surface layer:
0 to 9 inches—dark yellowish brown loamy sand
Subsurface layer:
9 to 19 inches—yellowish brown loamy sand
Subsoil:
19 to 60 inches—yellowish brown, loose sand with bands of strong brown, friable sandy loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid
Available water capacity: Low
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Slow
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Slight
Hazard of wind erosion: Moderate
Shrink-swell potential: Low

Composition

Spinks soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The loamy, moderately well drained Glynwood and Williamstown soils in landscape positions similar to those of the Spinks soil
• The somewhat poorly drained Thetford soils in drainageways and on foot slopes

Similar inclusions:
• Soils that have less clay in the subsoil
• Soils that have a substratum of stratified sand and gravel

Use and Management

Land use: Dominant use—cropland; other uses—pasture, woodland, building sites

Cropland
Major management concerns: Low available water capacity, wind erosion, nutrient loss

Management measures:
• Conservation tillage and cover crops help to control wind erosion.
• Timing fertilizer applications so that they meet crop nutrient needs, using split fertilizer applications, and applying fertilizer in bands may reduce the risk of nutrient leaching.
• Increasing the organic matter content in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and may reduce the risk of ground-water pollution.
• Managing irrigation water reduces the amount of nitrogen leached from irrigated fields.
• Using a system of conservation tillage, leaving crop residue on the surface, and adding other organic material conserve moisture.
• Drought-tolerant crops should be selected for planting, or the soil should be irrigated.

Pasture
Major management concerns: Low available water capacity, overgrazing
Management measures:
• Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: None

Buildings
Major management concerns: Cutbanks cave
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields
Major management concerns: None
Management measures:
• This soil is well suited to septic tank absorption fields.

Interpretive Groups

Land capability classification: IIIs
Woodland ordination symbol: 4A
Michigan soil management group: 4a

24C—Spinks loamy sand, 6 to 12 percent slopes

Setting

Landform: Outwash plains, till plains
Position on the landform: Knolls and foot slopes
Shape of areas: Irregular
Size of areas: 3 to 100 acres

Typical Profile

Surface layer:
0 to 9 inches—dark yellowish brown loamy sand
Subsurface layer:
9 to 19 inches—yellowish brown loamy sand
Subsoil:
19 to 60 inches—yellowish brown, loose sand with bands of strong brown, friable sandy loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid
Available water capacity: Low
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Slow
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Slight
Hazard of wind erosion: Moderate
Shrink-swell potential: Low

Composition

Spinks soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The loamy, well drained Morley and Miami soils in landscape positions similar to those of the Spinks soil
• The somewhat poorly drained Thetford soils in drainageways and on foot slopes
Similar inclusions:
• Soils that have less clay in the subsoil
• Soils that have a substratum of stratified sand and gravel

Use and Management

Land use: Dominant use—cropland; other uses—pasture, woodland, building sites

Cropland
Major management concerns: Low available water capacity, water erosion, wind erosion, nutrient loss
Management measures:
• Conservation tillage and crop rotations that include small grain help to prevent excessive soil loss.
• Grassed waterways, water- and sediment-control basins, diversions, and grade-stabilization structures help to prevent gully erosion.
• Properly regulating the application of irrigation water helps to control runoff and water erosion.
• Conservation tillage and cover crops help to control wind erosion.
• Timing fertilizer applications so that they meet crop

nutrient needs, using split fertilizer applications, and applying fertilizer in bands may reduce the risk of nutrient leaching.
• Increasing the organic matter content in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and may reduce the risk of ground-water pollution.
• Using a system of conservation tillage, leaving crop residue on the surface, and adding other organic material conserve moisture.
• Drought-tolerant crops should be selected for planting.

Pasture
Major management concerns: Low available water capacity, overgrazing
Management measures:
• Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: None

Buildings
Major management concerns: Slope, cutbanks cave
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.
• Some land grading may be needed.

Septic tank absorption fields
Major management concerns: Slope
Management measures:
• Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly.

Interpretive Groups

Land capability classification: IIIe
Woodland ordination symbol: 4A
Michigan soil management group: 4a

24D—Spinks loamy sand, 12 to 18 percent slopes

Setting

Landform: Outwash plains, till plains
Position on the landform: Back slopes
Shape of areas: Irregular
Size of areas: 3 to 100 acres

Typical Profile

Surface layer:
0 to 9 inches—dark yellowish brown loamy sand
Subsurface layer:
9 to 19 inches—yellowish brown loamy sand
Subsoil:
19 to 60 inches—yellowish brown, loose sand with bands of strong brown, friable sandy loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid
Available water capacity: Low
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Slow
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Moderate
Hazard of wind erosion: Moderate
Shrink-swell potential: Low

Composition

Spinks soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The loamy, well drained Morley and Miami soils in landscape positions similar to those of the Spinks soil
• The somewhat poorly drained Thetford soils in drainageways and on toe slopes
Similar inclusions:
• Soils that have less clay in the subsoil
• Soils that have a substratum of stratified sand and gravel

Use and Management

Land use: Dominant use—pasture; other uses—cropland, woodland, building sites

Cropland
Major management concerns: Low available water capacity, water erosion, wind erosion, nutrient loss
Management measures:
• Crop rotations that include grasses or legumes, conservation tillage, and cover crops help to control water erosion.
• Grassed waterways, water- and sediment-control basins, diversions, and grade-stabilization structures help to prevent gully erosion.
• Growing grasses and legumes for pasture or hay is effective in controlling erosion.
• Conservation tillage and crop rotations that include small grain help to prevent excessive soil loss.
• Timing fertilizer applications so that they meet crop nutrient needs, using split fertilizer applications, and applying fertilizer in bands may reduce the risk of nutrient leaching.

• Increasing the organic matter content in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and may reduce the risk of ground-water pollution.
• Conservation tillage systems, contour farming, cover crops, and sod-based rotations minimize the detachment and loss of nutrients associated with sediment, thus minimizing the losses of solid-phase nitrogen and phosphorus.
• Using a system of conservation tillage, leaving crop residue on the surface, and adding other organic material conserve moisture.
• Drought-tolerant crops should be selected for planting.

Pasture
Major management concerns: Low available water capacity, overgrazing
Management measures:
• Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: None

Buildings
Major management concerns: Slope, cutbanks cave
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.
• Buildings should be designed so that they conform to the natural slope of the land. Land shaping is necessary in some areas.

Septic tank absorption fields
Major management concerns: Slope
Management measures:
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

Interpretive Groups

Land capability classification: IVe
Woodland ordination symbol: 4A
Michigan soil management group: 4a

25B—Thetford loamy sand, 0 to 4 percent slopes

Setting

Landform: Outwash plains
Position on the landform: Foot slopes and low flat areas
Shape of areas: Irregular
Size of areas: 3 to 120 acres

Typical Profile

Surface layer:
0 to 10 inches—very dark grayish brown loamy sand
Subsoil:
10 to 24 inches—brown, mottled, friable loamy sand
24 to 60 inches—light yellowish brown, mottled, loose sand with bands of yellowish brown, friable loamy sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid
Available water capacity: Low
Drainage class: Somewhat poorly drained
Seasonal high water table: At a depth of 1 to 2 feet from February through May
Surface runoff: Slow
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Slight
Hazard of wind erosion: Moderate
Shrink-swell potential: Low

Composition

Thetford soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The well drained Spinks soils in the higher landscape positions
• The very poorly drained, organic Adrian soils in depressions

Similar inclusions:
• Soils that have more clay in the subsoil
• Soils that have a substratum of stratified sand and gravel

Use and Management

Land use: Dominant use—cropland; other uses—pasture, woodland, building sites

Cropland
Major management concerns: Seasonal wetness, low available water capacity, wind erosion, nutrient loss
Management measures:
• Conservation tillage and cover crops help to control wind erosion.
• Timing fertilizer applications so that they meet crop nutrient needs, using split fertilizer applications, and applying fertilizer in bands may reduce the risk of nutrient leaching.
• Increasing the organic matter content in the root zone may increase the ability of the soil to hold water,

nutrients, and pesticides and may reduce the risk of ground-water pollution.
• Most climatically adapted crops can be grown if an adequate drainage system is installed.
• Subsurface drains can reduce the wetness if a suitable outlet is available.
• Overdrainage can result in droughtiness.
• Using a system of conservation tillage, leaving crop residue on the surface, and adding other organic material conserve moisture.

Pasture
Major management concerns: Low available water capacity, seasonal wetness, overgrazing
Management measures:
• The quality and quantity of forage can be maintained by controlled or rotational grazing, restricted grazing during the drier periods, clipping, weed control, and annual applications of fertilizer.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: Equipment limitations
Management measures:
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.

Buildings
Major management concerns: Wetness, cutbanks cave
Management measures:
• Constructing buildings on well compacted fill material raises the site a sufficient distance above the water table.
• Wetness can be reduced by installing a drainage system around structures with basements and crawl spaces.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields
Major management concerns: Wetness
Management measures:
• Filling or mounding with suitable material helps to raise the absorption field above the water table.

Interpretive Groups

Land capability classification: IIIw
Woodland ordination symbol: 3W
Michigan soil management group: 4b

29B—Steamburg sandy loam, 2 to 6 percent slopes

Setting

Landform: Ground moraines, till plains
Position on the landform: Broad plains and low knolls
Shape of areas: Irregular
Size of areas: 3 to 300 acres

Typical Profile

Surface layer:
0 to 9 inches—dark grayish brown sandy loam
Subsoil:
9 to 34 inches—dark yellowish brown, friable sandy loam and light yellowish brown loamy sand
34 to 40 inches—yellowish brown, mottled, firm clay loam
Substratum:
40 to 60 inches—dark brown clay loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid in the upper part, moderately slow in the lower part
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Slow
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Slight
Hazard of wind erosion: Moderate
Shrink-swell potential: Low

Composition

Steamburg soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The well drained Fox soils that have a substratum of sand and gravel; in landscape positions similar to those of the Steamburg soil
• The sandy, well drained Spinks soils in landscape positions similar to those of the Steamburg soil
• The moderately well drained Williamstown soils, which have more clay in the subsoil than the Steamburg soil; in the slightly lower positions on the landscape
Similar inclusions:
• Areas that are moderately well drained

Use and Management

Land use: Dominant use—cropland; other uses—pasture, woodland, building sites

Cropland
Major management concerns: Wind erosion, water erosion
Management measures:
• Conservation tillage and crop residue management help to control wind erosion.
• Including grasses and legumes in the rotation minimizes nutrient losses, improves soil structure, and provides nitrogen for subsequent crops.

Pasture
Major management concerns: Overgrazing
Management measures:
• Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: None

Buildings
Major management concerns: None
Management measures:
• This soil is well suited to building site development.

Septic tank absorption fields
Major management concerns: Restricted permeability
Management measures:
• Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.

Interpretive Groups

Land capability classification: IIs
Woodland ordination symbol: 4A
Michigan soil management group: 2.5a

29C—Steamburg sandy loam, 6 to 12 percent slopes

Setting

Landform: Ground moraines, end moraines
Position on the landform: Knolls and foot slopes
Shape of areas: Irregular
Size of areas: 3 to 200 acres

Typical Profile

Surface layer:
0 to 9 inches—dark grayish brown sandy loam
Subsoil:
9 to 34 inches—dark yellowish brown, friable sandy loam and light yellowish brown loamy sand
34 to 40 inches—yellowish brown, mottled, firm clay loam
Substratum:
40 to 60 inches—dark brown clay loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid in the upper part, moderately slow in the lower part
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Medium
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Moderate
Hazard of wind erosion: Moderate
Shrink-swell potential: Low

Composition

Steamburg soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The well drained Fox soils that have a substratum of sand and gravel; in landscape positions similar to those of the Steamburg soil
• The sandy, well drained Spinks soils in landscape positions similar to those of the Steamburg soil
• The well drained Miami soils, which have more clay in the surface layer and the upper part of the subsoil than the Steamburg soil; in landscape positions similar to those of the Steamburg soil
Similar inclusions:
• Areas that are moderately well drained

Use and Management

Land use: Dominant use—cropland; other uses—pasture, woodland, building sites

Cropland
Major management concerns: Water erosion, wind erosion
Management measures:
• Conservation tillage and crop rotations that include small grain help to prevent excessive soil loss.
• Grassed waterways, water- and sediment-control basins, diversions, and grade-stabilization structures help to prevent gully erosion.
• Contour farming, contour stripcropping, and terraces reduce the runoff rate and help to control water erosion.
• Conservation tillage and crop residue management help to control wind erosion.
• Including grasses and legumes in the rotation minimizes nutrient losses, improves soil structure, and provides nitrogen for subsequent crops.

Pasture
Major management concerns: Overgrazing
Management measures:
• Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: None

Buildings
Major management concerns: Slope
Management measures:
• Some land grading may be needed.

Septic tank absorption fields
Major management concerns: Slope, restricted permeability
Management measures:
• Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly.
• Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.

Interpretive Groups

Land capability classification: IIIe
Woodland ordination symbol: 4A
Michigan soil management group: 2.5a

29D—Steamburg sandy loam, 12 to 18 percent slopes

Setting

Landform: End moraines
Position on the landform: Back slopes
Shape of areas: Irregular
Size of areas: 3 to 100 acres

Typical Profile

Surface layer:
0 to 9 inches—dark grayish brown sandy loam
Subsoil:
9 to 34 inches—dark yellowish brown, friable sandy loam and light yellowish brown loamy sand
34 to 40 inches—yellowish brown, mottled, firm clay loam
Substratum:
40 to 60 inches—dark brown clay loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid in the upper part, moderately slow in the lower part
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Rapid
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Severe
Hazard of wind erosion: Moderate
Shrink-swell potential: Low

Composition

Steamburg soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The well drained Fox soils that have a substratum of sand and gravel; in landscape positions similar to those of the Steamburg soil
• The sandy, well drained Spinks soils in landscape positions similar to those of the Steamburg soil
• The well drained Miami soils, which have more clay in the surface layer and the upper part of the subsoil than the Steamburg soil; in landscape positions similar to those of the Steamburg soil

Similar inclusions:
• Areas that are moderately well drained

Use and Management

Land use: Dominant use—pasture; other uses—cropland, woodland, building sites

Cropland
Major management concerns: Water erosion, wind erosion, nutrient loss
Management measures:
• Conservation tillage and crop rotations that include grasses or legumes, conservation tillage, and cover crops help to control water erosion.
• Grassed waterways, water- and sediment-control basins, diversions, and grade-stabilization structures help to prevent gully erosion.
• Contour farming, contour stripcropping, and terraces reduce the runoff rate and help to control water erosion.
• Growing grasses and legumes for pasture or hay is effective in controlling erosion.
• Conservation tillage and crop residue management help to control wind erosion.
• Conservation tillage systems, contour farming, cover crops, and sod-based rotations minimize the detachment and loss of nutrients associated with sediment, thus minimizing the losses of solid-phase nitrogen and phosphorus.

Pasture
Major management concerns: Overgrazing
Management measures:
• Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: None

Buildings
Major management concerns: Slope
Management measures:
• Buildings should be designed so that they conform to the natural slope of the land. Land shaping is necessary in some areas.

Septic tank absorption fields
Major management concerns: Slope, restricted permeability
Management measures:
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.
• Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.

Interpretive Groups

Land capability classification: IVe
Woodland ordination symbol: 4A
Michigan soil management group: 2.5a

32—Sloan silt loam, frequently flooded

Setting

Landform: Flood plains
Position on the landform: Depressions and old oxbows
Shape of areas: Linear
Size of areas: 5 to 250 acres

Typical Profile

Surface layer:
0 to 16 inches—very dark grayish brown silt loam
Subsoil:
16 to 25 inches—dark gray, mottled, friable loam with bands of black organic material
25 to 31 inches—dark grayish brown, mottled, firm loam
Substratum:
31 to 42 inches—grayish brown, mottled, stratified silt loam and fine sandy loam
42 to 60 inches—dark gray, mottled, stratified silt loam and fine sandy loam with bands of black organic material

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately slow
Available water capacity: High
Drainage class: Very poorly drained
Seasonal high water table: Near the surface to 1 foot below the surface from November through June
Surface runoff: Very slow
Flooding: Frequent
Organic matter content: High
Hazard of water erosion: Slight
Hazard of wind erosion: Slight
Shrink-swell potential: Moderate

Composition

Sloan soil and similar soils: 95 to 100 percent
Contrasting inclusions: 0 to 5 percent

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Conover soils in the slightly higher positions on the landscape
• The very poorly drained, organic Houghton soils in depressions
• The very poorly drained, sandy Glendora soils in landscape positions similar to those of the Sloan soil
Similar inclusions:
• Soils that have a mucky surface layer
• Areas that are rarely flooded

Use and Management

Land use: Dominant use—woodland; other uses—cropland, pasture

Cropland
Major management concerns: Seasonal wetness, flooding, soil compaction, soil tilth
Management measures:
• Most climatically adapted crops can be grown if an adequate drainage system is installed and flooding is controlled.
• Improving drainage is difficult because most areas are seasonally flooded and have poor outlets.
• Crop residue management, green manure crops, applications of manure, cover crops, conservation tillage, and a cropping sequence that includes grasses and legumes maintain or improve tilth and increase the available water capacity and the organic matter content.
• Minimizing tillage and tilling and harvesting at the proper soil moisture content help to prevent excessive compaction and maintain tilth.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in

the cropping sequence improve soil structure, water infiltration, and permeability.
• If a good surface drainage system is installed, late-planted crops can be grown after the normal flooding period.

Pasture
Major management concerns: Compaction, flooding, seasonal wetness
Management measures:
• Proper stocking rates, a planned grazing system, and deferred grazing during wet periods help to keep the pasture in good condition.
• Hay and pasture plants that can withstand periodic inundation and seasonal wetness should be seeded.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants.

Woodland
Major management concerns: Equipment limitations, seedling mortality, windthrow hazard
Management measures:
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Skidders should not be used during wet periods, when ruts form easily.
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
• Because of wetness, severe seedling mortality, and plant competition, trees are generally not planted on this soil.
• Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by such harvest methods as selective cutting and strip cutting.

Buildings
Major management concerns: Wetness
Management measures:
• An alternative site should be selected.

Septic tank absorption fields
Major management concerns: Flooding
Management measures:
• Because of the flooding and the seasonal high water table, alternative sites should be selected.

Interpretive Groups

Land capability classification: IIIw
Woodland ordination symbol: 3W
Michigan soil management group: L-2c

33—Houghton muck

Setting

Landform: Ground moraines, end moraines, flood plains, lake plains
Position on the landform: Depressions
Shape of areas: Irregular
Size of areas: 5 to 420 acres

Typical Profile

Surface layer:
0 to 9 inches—black and very dark brown muck
Subsoil:
9 to 44 inches—black, friable muck
Substratum:
44 to 60 inches—very dark brown muck

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately slow to moderately rapid
Available water capacity: Very high
Drainage class: Very poorly drained
Seasonal high water table: 1 foot above to 1 foot below the surface from September through June
Surface runoff: Very slow or ponded
Flooding: None
Organic matter content: Very high
Hazard of water erosion: Slight
Hazard of wind erosion: Moderate
Shrink-swell potential: Low

Composition

Houghton soil and similar soils: 95 to 100 percent
Contrasting inclusions: 0 to 5 percent

Inclusions

Contrasting inclusions:
• The very poorly drained, mineral Glendora, Sloan, and Wolcott soils in landscape positions similar to those of the Houghton soil
• The very poorly drained Edwards soils, which are underlain with marl; in landscape positions similar to those of the Houghton soil

Similar inclusions:
• Organic soils that have sandy or loamy material above a depth of 51 inches

Use and Management

Land use: Dominant use—woodland; other uses—cropland, pasture

Cropland
Major management concerns: Seasonal wetness, wind erosion, ponding, subsidence

Management measures:
• Conservation tillage and cover crops help to control wind erosion.
• Most climatically adapted crops can be grown if an adequate drainage system is installed.
• Improving drainage is difficult because most areas have poor outlets.
• Management of the water table determines the rate of subsidence. Overdrainage will increase the rate.

Pasture
Major management concerns: Compaction, seasonal wetness
Management measures:
• Hay and pasture plants that can withstand periodic inundation and seasonal wetness should be seeded.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.

Woodland
Major management concerns: Equipment limitations, seedling mortality, windthrow hazard
Management measures:
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Special harvesting equipment is needed. The equipment can be used only during periods in winter when skid roads and access roads are frozen.
• Because of wetness, severe seedling mortality, and plant competition, trees are generally not planted on this soil.
• Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by such harvest methods as selective cutting and strip cutting.

Interpretive Groups

Land capability classification: Vw
Woodland ordination symbol: 2W
Michigan soil management group: Mc

34—Adrian muck

Setting

Landform: Outwash plains, lake plains, flood plains
Position on the landform: Depressions
Shape of areas: Irregular
Size of areas: 5 to 200 acres

Typical Profile

Surface layer:
0 to 7 inches—black muck
Subsoil:
7 to 19 inches—black, friable muck
19 to 26 inches—very dark gray, friable muck
Substratum:
26 to 60 inches—very dark gray and very dark grayish brown sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately slow to moderately rapid in the upper part, rapid in the lower part
Available water capacity: Very high
Drainage class: Very poorly drained
Seasonal high water table: 1 foot above to 1 foot below the surface from November through May
Surface runoff: Very slow or ponded
Flooding: None
Organic matter content: Very high
Hazard of water erosion: Slight
Hazard of wind erosion: Moderate
Shrink-swell potential: Low

Composition

Adrian soil and similar soils: 95 to 100 percent
Contrasting inclusions: 0 to 5 percent

Inclusions

Contrasting inclusions:
• The poorly drained Gilford soils in landscape positions similar to those of the Adrian soil
• The very poorly drained, sandy Glendora soils in landscape positions similar to those of the Adrian soil
• The very poorly drained Edwards soils, which are underlain with marl; in landscape positions similar to those of the Adrian soil

Similar inclusions:
• Organic soils that have loamy material above a depth of 51 inches
• Soils that are muck throughout

Use and Management

Land use: Dominant use—woodland; other uses—cropland, pasture

Cropland
Major management concerns: Seasonal wetness, wind erosion, ponding, subsidence
Management measures:
• Conservation tillage and cover crops help to control wind erosion.
• Most climatically adapted crops can be grown if an adequate drainage system is installed.
• Improving drainage is difficult because most areas have poor outlets.
• Management of the water table determines the rate of subsidence. Overdrainage will increase the rate.

Pasture
Major management concerns: Compaction, seasonal wetness
Management measures:
• Hay and pasture plants that can withstand periodic inundation and seasonal wetness should be seeded.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.

Woodland
Major management concerns: Equipment limitations, seedling mortality, windthrow hazard
Management measures:
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Special harvesting equipment is needed. The equipment can be used only during periods in winter when skid roads and access roads are frozen.
• Because of wetness, severe seedling mortality, and plant competition, trees are generally not planted on this soil.
• Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by such harvest methods as selective cutting and strip cutting.

Interpretive Groups

Land capability classification: Vw
Woodland ordination symbol: 2W
Michigan soil management group: M/4c

35—Palms muck

Setting

Landform: Ground moraines, end moraines, lake plains
Position on the landform: Depressions
Shape of areas: Irregular
Size of areas: 5 to 45 acres

Typical Profile

Surface layer:
0 to 13 inches—black muck
Subsoil:
13 to 16 inches—very dark grayish brown, friable muck
Substratum:
16 to 23 inches—dark yellowish brown, mottled silt loam
23 to 28 inches—grayish brown, mottled silt loam
28 to 60 inches—gray, mottled, stratified sandy loam and silty clay loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately slow to moderately rapid in the upper part, moderately slow or moderate in the lower part
Available water capacity: Very high
Drainage class: Very poorly drained
Seasonal high water table: 1 foot above to 1 foot below the surface from November through May
Surface runoff: Very slow or ponded
Flooding: None
Organic matter content: Very high
Hazard of water erosion: Slight
Hazard of wind erosion: Moderate
Shrink-swell potential: Low

Composition

Palms soil and similar soils: 95 to 100 percent
Contrasting inclusions: 0 to 5 percent

Inclusions

Contrasting inclusions:
• The very poorly drained, mineral Wolcott and Sloan soils in landscape positions similar to those of the Palms soil
• The very poorly drained Edwards soils, which are underlain with marl; in landscape positions similar to those of the Palms soil

Similar inclusions:
• Organic soils that have sandy material above a depth of 51 inches
• Soils that are muck throughout

Use and Management

Land use: Dominant use—woodland; other uses—cropland, pasture

Cropland
Major management concerns: Seasonal wetness, wind erosion, ponding, subsidence
Management measures:
• Conservation tillage and cover crops help to control wind erosion.
• Most climatically adapted crops can be grown if an adequate drainage system is installed.
• Improving drainage is difficult because most areas have poor outlets.
• Management of the water table determines the rate of subsidence. Overdrainage will increase the rate.

Pasture
Major management concerns: Compaction, seasonal wetness
Management measures:
• Hay and pasture plants that can withstand periodic inundation and seasonal wetness should be seeded.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.

Woodland
Major management concerns: Equipment limitations, seedling mortality, windthrow hazard
Management measures:
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Special harvesting equipment is needed. The equipment can be used only during periods in winter when skid roads and access roads are frozen.
• Because of wetness, severe seedling mortality, and plant competition, trees are generally not planted on this soil.
• Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by such harvest methods as selective cutting and strip cutting.

Interpretive Groups

Land capability classification: Vw
Woodland ordination symbol: 2W
Michigan soil management group: M/3c

37A—Matherton loam, 0 to 3 percent slopes

Setting

Landform: Outwash plains
Position on the landform: Foot slopes and low flat areas
Shape of areas: Irregular
Size of areas: 5 to 500 acres

Typical Profile

Surface layer:
0 to 9 inches—dark brown loam
Subsoil:
9 to 15 inches—dark yellowish brown, mottled, friable sandy clay loam
15 to 23 inches—dark yellowish brown, mottled, friable loam
23 to 25 inches—dark grayish brown, mottled, friable gravelly loam
Substratum:
25 to 38 inches—grayish brown gravelly coarse sand
38 to 60 inches—dark gray, mottled fine sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate in the upper part, rapid in the lower part
Available water capacity: Low
Drainage class: Somewhat poorly drained
Seasonal high water table: At a depth of 1 to 2 feet from November through May
Surface runoff: Very slow
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Slight
Hazard of wind erosion: Slight
Shrink-swell potential: Moderate

Composition

Matherton soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Fox soils in the higher landscape positions
• The moderately well drained Williamstown and Glynwood soils, which have more clay in the substratum than the Matherton soil; in the slightly higher positions on the landscape
• The poorly drained Sebewa soils in depressions
Similar inclusions:
• Soils that have a surface layer of sandy loam

Use and Management

Land use: Dominant use—cropland (fig. 6); other uses—pasture, woodland, building sites

Cropland
Major management concerns: Seasonal wetness, soil compaction, soil tilth, low available water capacity
Management measures:
• Timing fertilizer applications so that they meet crop nutrient needs, using split fertilizer applications, and applying fertilizer in bands may reduce the risk of nutrient leaching.
• Including grasses and legumes in the rotation minimizes nutrient losses, improves soil structure, and provides nitrogen for subsequent crops.
• Most climatically adapted crops can be grown if an adequate drainage system is installed.
• Subsurface drains can reduce the wetness if a suitable outlet is available.
• Overdrainage can result in droughtiness.
• Using a system of conservation tillage, leaving crop residue on the surface, and adding other organic material conserve moisture.
• Crop residue management, green manure crops, applications of manure, cover crops, conservation tillage, and a cropping sequence that includes grasses and legumes maintain or improve tilth and increase the available water capacity and the organic matter content.
• Minimizing tillage and tilling and harvesting at the proper soil moisture content help to prevent excessive compaction and maintain tilth.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in

Figure 6.—Soybeans in an area of Matherton loam, 0 to 3 percent slopes.

the cropping sequence improve soil structure, water infiltration, and permeability.

Pasture

Major management concerns: Compaction, seasonal wetness

Management measures:

• Proper stocking rates, a planned grazing system, and deferred grazing during wet periods help to keep the pasture in good condition.

• Restricted grazing during wet periods helps to prevent compaction and poor tilth.

• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Equipment limitations

Management measures:

• Skidders should not be used during wet periods, when ruts form easily.

• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.

Buildings

Major management concerns: Wetness, cutbanks cave

Management measures:

• Constructing buildings on well compacted fill material raises the site a sufficient distance above the water table.

• Wetness can be reduced by installing a drainage system around structures with basements and crawl spaces.

• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields
Major management concerns: Wetness, poor filter
Management measures:
• The poor filtering capacity of this soil can result in the pollution of ground water.
• Filling or mounding with suitable material helps to raise the absorption field above the water table.

Interpretive Groups

Land capability classification: IIw
Woodland ordination symbol: 4W
Michigan soil management group: M/3c

38—Edwards muck

Setting

Landform: Ground moraines, end moraines, lake plains
Position on the landform: Depressions
Shape of areas: Irregular
Size of areas: 5 to 45 acres

Typical Profile

Surface layer:
0 to 10 inches—black muck

Subsoil:
10 to 18 inches—dark brown, friable muck

Substratum:
18 to 60 inches—grayish brown, mottled marl

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately slow to moderately rapid
Available water capacity: Moderate
Drainage class: Very poorly drained
Seasonal high water table: 1 foot above to 1 foot below the surface from September through June
Surface runoff: Very slow or ponded
Flooding: None
Organic matter content: Very high
Hazard of water erosion: Slight
Hazard of wind erosion: Moderate
Shrink-swell potential: Variable

Composition

Edwards soil and similar soils: 95 to 100 percent
Contrasting inclusions: 0 to 5 percent

Inclusions

Contrasting inclusions:
• The very poorly drained Wolcott soils in landscape positions similar to those of the Edwards soil

Similar inclusions:
• Organic soils that have sandy or loamy material above a depth of 51 inches
• Areas that are muck throughout

Use and Management

Land use: Dominant use—woodland; other uses—cropland, pasture

Cropland
Major management concerns: Seasonal wetness, wind erosion, ponding, subsidence
Management measures:
• Conservation tillage and cover crops help to control wind erosion.
• Most climatically adapted crops can be grown if an adequate drainage system is installed.
• Improving drainage is difficult because most areas have poor outlets.
• Management of the water table determines the rate of subsidence. Overdrainage will increase the rate.

Pasture
Major management concerns: Compaction, seasonal wetness
Management measures:
• Hay and pasture plants that can withstand periodic inundation and seasonal wetness should be seeded.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.

Woodland
Major management concerns: Equipment limitation, seedling mortality, windthrow hazard
Management measures:
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Special harvesting equipment is needed. The equipment can be used only during periods in winter when skid roads and access roads are frozen.
• Because of wetness, severe seedling mortality, and plant competition, trees are generally not planted on this soil.
• Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by such harvest methods as selective cutting and strip cutting.

Interpretive Groups

Land capability classification: Vw
Woodland ordination symbol: 2W
Michigan soil management group: M/Mc

39—Gilford sandy loam

Setting

Landform: Outwash plains
Position on the landform: Depressions
Shape of areas: Oval, linear
Size of areas: 5 to 160 acres

Typical Profile

Surface layer:
0 to 16 inches—black and very dark gray sandy loam

Subsoil:
16 to 36 inches—grayish brown, mottled, friable sandy loam

Substratum:
36 to 42 inches—grayish brown, mottled loamy sand
42 to 60 inches—gray, stratified sand and gravel

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid in the upper part, very rapid in the lower part
Available water capacity: Moderate
Drainage class: Poorly drained
Seasonal high water table: 0.5 foot above to 1.0 foot below the surface from December through May
Surface runoff: Very slow or ponded
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Slight
Hazard of wind erosion: Moderate
Shrink-swell potential: Low

Composition

Gilford soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The well drained Fox soils in the higher positions on the landscape
• The very poorly drained, organic Houghton soils in depressions

Similar inclusions:
• Soils that have a surface layer of loamy sand
• Soils that have a mucky surface layer

Use and Management

Land use: Dominant use—cropland; other uses—woodland, pasture

Cropland
Major management concerns: Seasonal wetness, ponding, low available water capacity, wind erosion, nutrient loss
Management measures:
• Conservation tillage and crop residue management help to control wind erosion.
• Timing fertilizer applications so that they meet crop nutrient needs, using split fertilizer applications, and applying fertilizer in bands may reduce the risk of nutrient leaching.
• Most climatically adapted crops can be grown if an adequate drainage system is installed.
• Subsurface drains can reduce the wetness if a suitable outlet is available.
• Overdrainage can result in droughtiness.

Pasture
Major management concerns: Compaction, seasonal wetness
Management measures:
• Proper stocking rates, a planned grazing system, and deferred grazing during wet periods help to keep the pasture in good condition.
• Hay and pasture plants that can withstand periodic inundation and seasonal wetness should be seeded.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants.

Woodland
Major management concerns: Equipment limitations, seedling mortality, windthrow hazard
Management measures:
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
• Because of wetness, severe seedling mortality, and plant competition, trees are generally not planted on this soil.
• Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by such harvest methods as selective cutting and strip cutting.

Buildings
Major management concerns: Ponding, cutbanks cave
Management measures:
• An alternative site should be selected.

Septic tank absorption fields
Major management concerns: Ponding
Management measures:
• Because of ponding, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: IIIw
Woodland ordination symbol: 2W
Michigan soil management group: 4c

40A—Locke fine sandy loam, 0 to 3 percent slopes

Setting

Landform: Ground moraines
Position on the landform: Foot slopes and low flat areas
Shape of areas: Irregular
Size of areas: 5 to 300 acres

Typical Profile

Surface layer:
0 to 9 inches—very dark grayish brown fine sandy loam

Subsoil:
9 to 14 inches—yellowish brown, mottled, firm loam
14 to 37 inches—brown, mottled, firm loam

Substratum:
37 to 60 inches—brown, mottled fine sandy loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate
Available water capacity: High
Drainage class: Somewhat poorly drained
Seasonal high water table: At a depth of 1 to 2 feet from November through May
Surface runoff: Slow
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Slight
Hazard of wind erosion: Moderate
Shrink-swell potential: Low

Composition

Locke soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained Hillsdale and Riddles soils in the higher positions on the landscape

Similar inclusions:
• Soils that have a surface layer of loam
• Soils that are moderately well drained

Use and Management

Land use: Dominant use—cropland; other uses—pasture, woodland, building sites

Cropland
Major management concerns: Seasonal wetness, wind erosion
Management measures:
• Conservation tillage and crop residue management help to control wind erosion.
• Most climatically adapted crops can be grown if an adequate drainage system is installed.
• Subsurface drains can reduce the wetness if a suitable outlet is available.

Pasture
Major management concerns: Compaction, seasonal wetness
Management measures:
• Proper stocking rates, a planned grazing system, and deferred grazing during wet periods help to keep the pasture in good condition.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants.

Woodland
Major management concerns: Equipment limitations, windthrow hazard
Management measures:
• Skidders should not be used during wet periods, when ruts form easily.
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
• Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by such harvest methods as selective cutting and strip cutting.

Buildings
Major management concerns: Seasonal wetness
Management measures:
• Constructing buildings on well compacted fill material raises the site a sufficient distance above the water table.
• Wetness can be reduced by installing a drainage system around structures with basements and crawl spaces.

Septic tank absorption fields
Major management concerns: Seasonal wetness, restricted permeability
Management measures:
• Filling or mounding with suitable material helps to raise the absorption field above the water table.

Interpretive Groups

Land capability classification: IIw

Woodland ordination symbol: 4W
Michigan soil management group: 3b

42B—Riddles sandy loam, 2 to 6 percent slopes

Setting

Landform: End moraines, ground moraines
Position on the landform: Broad plains and low knolls
Shape of areas: Irregular
Size of areas: 5 to 500 acres

Typical Profile

Surface layer:
0 to 10 inches—very dark grayish brown sandy loam

Subsurface layer:
10 to 17 inches—yellowish brown sandy loam

Subsoil:
17 to 22 inches—dark yellowish brown, firm sandy loam
22 to 40 inches—dark yellowish brown, firm sandy clay loam

Substratum:
40 to 60 inches—brown sandy loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Slow
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Slight
Hazard of wind erosion: Moderate
Shrink-swell potential: Moderate

Composition

Riddles soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The sandy, well drained Spinks soils in landscape positions similar to those of the Riddles soil
• The somewhat poorly drained Locke soils in drainageways and on foot slopes

Similar inclusions:
• Soils that have more sand in the lower part of the profile
• Areas that are moderately well drained
• Soils that have a surface layer of loam

Use and Management

Land use: Dominant use—cropland; other uses—pasture, woodland, building sites

Cropland
Major management concerns: Wind erosion, water erosion
Management measures:
• Conservation tillage and crop rotations that include grasses and legumes and small grain help to control runoff and water erosion.
• Properly regulating the application of irrigation water helps to control runoff and water erosion.
• Conservation tillage and crop residue management help to control wind erosion.

Pasture
Major management concerns: Overgrazing
Management measures:
• Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: None

Buildings
Major management concerns: Shrink-swell
Management measures:
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.

Septic tank absorption fields
Major management concerns: Restricted permeability
Management measures:
• Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 5A
Michigan soil management group: 3a

42C2—Riddles sandy loam, 6 to 12 percent slopes, eroded

Setting

Landform: End moraines, ground moraines
Position on the landform: Knolls and foot slopes
Distinctive landscape features: Eroded surface
Shape of areas: Irregular
Size of areas: 5 to 500 acres

Typical Profile

Surface layer:
0 to 8 inches—very dark grayish brown sandy loam
Subsurface layer:
8 to 12 inches—yellowish brown sandy loam
Subsoil:
12 to 22 inches—dark yellowish brown, firm sandy loam
22 to 40 inches—dark yellowish brown, firm sandy clay loam
Substratum:
40 to 60 inches—brown sandy loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Medium
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Moderate
Hazard of wind erosion: Moderate
Shrink-swell potential: Moderate

Composition

Riddles soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The well drained, sandy Spinks soils in landscape positions similar to those of the Riddles soil
• The somewhat poorly drained Locke soils in drainageways and on foot slopes
Similar inclusions:
• Soils that have more sand in the lower part of the profile
• Areas that are not eroded

Use and Management

Land use: Dominant uses—cropland, pasture; other uses—woodland, building sites

Cropland
Major management concerns: Water erosion, wind erosion, nutrient loss
Management measures:
• Conservation tillage and crop rotations that include small grain help to prevent excessive soil loss.
• Grassed waterways, water- and sediment-control basins, diversions, and grade-stabilization structures help to prevent gully erosion.
• Contour farming, contour stripcropping, and terraces reduce the runoff rate and help to control water erosion.
• Properly regulating the application of irrigation water helps to control runoff and water erosion.
• Conservation tillage and crop residue management help to control wind erosion.
• Conservation tillage systems, contour farming, cover crops, and sod-based rotations minimize the detachment and loss of nutrients associated with sediment, thus minimizing the losses of solid-phase nitrogen and phosphorus.

Pasture
Major management concerns: Overgrazing
Management measures:
• Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: None

Buildings
Major management concerns: Slope, shrink-swell
Management measures:
• Some land grading may be needed.
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.

Septic tank absorption fields
Major management concerns: Slope, restricted permeability
Management measures:
• Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly.
• Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.

Interpretive Groups

Land capability classification: IIIe
Woodland ordination symbol: 5A
Michigan soil management group: 3a

42D2—Riddles sandy loam, 12 to 18 percent slopes, eroded

Setting

Landform: End moraines
Position on the landform: Back slopes
Distinctive landscape features: Eroded surface
Shape of areas: Irregular
Size of areas: 5 to 200 acres

Typical Profile

Surface layer:
0 to 8 inches—very dark grayish brown sandy loam
Subsurface layer:
8 to 12 inches—yellowish brown sandy loam
Subsoil:
12 to 31 inches—dark yellowish brown, firm sandy loam
31 to 40 inches—dark yellowish brown, firm sandy clay loam
Substratum:
40 to 60 inches—brown sandy loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Rapid
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Severe
Hazard of wind erosion: Moderate
Shrink-swell potential: Moderate

Composition

Riddles soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The well drained, sandy Spinks soils in landscape positions similar to those of the Riddles soil
• The somewhat poorly drained Locke soils in drainageways, on foot slopes, and in shallow depressions
Similar inclusions:
• Soils that have more sand in the lower part of the profile
• Areas that are not eroded
• Areas that are severely eroded

Use and Management

Land use: Dominant uses—cropland, pasture; other uses—woodland, building sites

Cropland
Major management concerns: Water erosion, wind erosion, nutrient loss
Management measures:
• Conservation tillage and crop rotations that include grasses or legumes, conservation tillage, and cover crops help to control water erosion.
• Grassed waterways, water- and sediment-control basins, diversions, and grade-stabilization structures can help to prevent gully erosion.
• Contour farming, contour stripcropping, and terraces reduce the runoff rate and help to control water erosion.
• Growing grasses and legumes for pasture or hay is effective in controlling erosion.
• Conservation tillage and crop residue management help to control wind erosion.
• Conservation tillage systems, contour farming, cover crops, and sod-based rotations minimize the detachment and loss of nutrients associated with sediment, thus minimizing the losses of solid-phase nitrogen and phosphorus.

Pasture
Major management concerns: Overgrazing
Management measures:
• Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: None

Buildings
Major management concerns: Slope, shrink-swell
Management measures:
• Buildings should be designed so that they conform to the natural slope of the land. Land shaping is necessary in some areas.
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.

Septic tank absorption fields
Major management concerns: Slope, restricted permeability
Management measures:
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.
• Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.

Interpretive Groups

Land capability classification: IVe
Woodland ordination symbol: 5A
Michigan soil management group: 3a

42E—Riddles sandy loam, 18 to 35 percent slopes

Setting

Landform: End moraines

Position on the landform: Shoulder slopes and ridges
Shape of areas: Linear
Size of areas: 5 to 100 acres

Typical Profile

Surface layer:
0 to 10 inches—very dark grayish brown sandy loam

Subsurface layer:
10 to 17 inches—yellowish brown sandy loam

Subsoil:
17 to 31 inches—dark yellowish brown, firm sandy loam
31 to 40 inches—dark yellowish brown, firm sandy clay loam

Substratum:
40 to 60 inches—brown sandy loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate
Available water capacity: Moderate
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Rapid
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Severe
Hazard of wind erosion: Moderate
Shrink-swell potential: Moderate

Composition

Riddles soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The well drained, sandy Spinks soils in landscape positions similar to those of the Riddles soil
• The somewhat poorly drained Locke soils in drainageways, on foot slopes, and in shallow depressions

Similar inclusions:
• Soils that have more sand in the lower part of the profile
• Areas that are eroded

Use and Management

Land use: Dominant use—pasture; other use—woodland

Cropland
Major management concerns: Slope
Management measures:
• Because of the slope, this soil is very difficult to manage and is generally not used for cultivated crops.

Pasture
Major management concerns: Overgrazing, water erosion, wind erosion
Management measures:
• Growing grasses and legumes for pasture or hay is effective in controlling erosion.
• Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: Equipment limitations, erosion hazard
Management measures:
• Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
• Seeding skid roads, logging roads, and landings after the trees are logged helps to control erosion.
• Areas sensitive to erosion, esthetics, and drought conditions may require mulch, such as straw, bark, or wood chips.

Buildings
Major management concerns: Slope, shrink-swell
Management measures:
• Because of the slope, this soil is poorly suited to building site development unless extensive land shaping is applied.
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.

Septic tank absorption fields
Major management concerns: Slope
Management measures:
• Because of the slope, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: VIe
Woodland ordination symbol: 5R
Michigan soil management group: 3a

43—Histosols and Aquents, ponded

Setting

Landform: Lake plains, flood plains
Position on the landform: Closed depressions
Shape of areas: Irregular
Size of areas: 3 to 200 acres

Typical Profile

Histosols
Texture: Muck

Aquents
Texture: Sandy to clayey material

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid to slow
Available water capacity: High
Drainage class: Very poorly drained
Seasonal high water table: 1 foot above to 1 foot below the surface from November through May
Surface runoff: Ponded
Flooding: None
Organic matter content: High
Hazard of water erosion: Slight
Hazard of wind erosion: Slight
Shrink-swell potential: Low

Composition

Histosols and similar soils: 0 to 70 percent
Aquents and similar soils: 25 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Blount, Matherton, and Thetford soils in the higher positions on the landscape

Similar inclusions:
• Small areas of poorly drained soils at the edges of the unit

Use and Management

Land use: Dominant use—wetland wildlife habitat

Interpretive Groups

Land capability classification: None
Woodland ordination symbol: None
Michigan soil management group: None

44B—Leoni gravelly sandy loam, 1 to 6 percent slopes

Setting

Landform: Outwash plains, kames
Position on the landform: Broad plains and low knolls
Shape of areas: Irregular
Size of areas: 5 to 400 acres

Typical Profile

Surface layer:
0 to 8 inches—dark brown gravelly sandy loam

Subsoil:
8 to 22 inches—brown, very firm very gravelly clay loam
22 to 34 inches—brown, friable extremely gravelly sandy loam
34 to 46 inches—dark brown, very friable extremely gravelly loamy sand and yellowish brown gravelly coarse sand

Substratum:
46 to 60 inches—yellowish brown gravelly coarse sand and gravel

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate in the upper part, rapid in the lower part
Available water capacity: Low
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Slow
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Slight
Hazard of wind erosion: Slight
Shrink-swell potential: Low

Composition

Leoni soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Matherton soils in drainageways and on foot slopes
• The well drained Boyer soils, which have less clay in the subsoil than the Leoni soil; in landscape positions similar to those of the Leoni soil

Similar inclusions:
• Soils that have less than 35 percent rock fragments in the subsoil
• Areas that are moderately well drained

Use and Management

Land use: Dominant use—cropland; other uses—pasture, woodland, building sites

Cropland
Major management concerns: Low available water capacity, nutrient loss, equipment limitations associated with a high cobble content
Management measures:
• Properly regulating the application of irrigation water helps to control runoff and water erosion.
• Timing fertilizer applications so that they meet crop nutrient needs, using split fertilizer applications, and

applying fertilizer in bands may reduce the risk of nutrient leaching.
• Managing irrigation water reduces the amount of nitrogen leached from irrigated fields.
• Using a system of conservation tillage, leaving crop residue on the surface, and adding other organic material conserve moisture.
• Drought-tolerant crops should be selected for planting, or the soil should be irrigated.
• Cobblestones in the surface layer interfere with the use of tillage, planting, and some harvesting equipment. Removing the cobblestones reduces wear on equipment.

Pasture
Major management concerns: Low available water capacity, overgrazing
Management measures:
• Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: None

Buildings
Major management concerns: Cutbanks cave
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields
Major management concerns: Poor filtering capacity
Management measures:
• The poor filtering capacity of this soil can result in the pollution of ground water.

Interpretive Groups

Land capability classification: IIIs
Woodland ordination symbol: 4A
Michigan soil management group: Ga

44C2—Leoni very gravelly sandy loam, 6 to 12 percent slopes, eroded

Setting

Landform: Outwash plains, kames
Position on the landform: Knolls and foot slopes
Distinctive landscape features: Eroded surface
Shape of areas: Irregular, oval
Size of areas: 5 to 200 acres

Typical Profile

Surface layer:
0 to 8 inches—dark brown very gravelly sandy loam
Subsoil:
8 to 18 inches—brown, firm very gravelly clay loam
18 to 30 inches—brown, friable extremely gravelly sandy loam
30 to 42 inches—dark brown, very friable extremely gravelly loamy sand and yellowish brown gravelly coarse sand
Substratum:
42 to 60 inches—yellowish brown gravelly coarse sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate in the upper part, rapid in the lower part
Available water capacity: Low
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Medium
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Moderate
Hazard of wind erosion: Slight
Shrink-swell potential: Low

Composition

Leoni soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained, sandy Spinks soils in landscape positions similar to those of the Leoni soil
• The well drained Boyer soils, which have less clay in the subsoil than the Leoni soil; in landscape positions similar to those of the Leoni soil
Similar inclusions:
• Soils that have less than 35 percent rock fragments in the subsoil
• Areas that are not eroded

Use and Management

Land use: Dominant use—cropland; other uses—pasture, woodland, building sites

Cropland
Major management concerns: Water erosion, low available water capacity, nutrient loss, equipment limitations associated with a high cobble content
Management measures:
• Conservation tillage and crop rotations that include small grain help to prevent excessive soil loss.
• Grassed waterways, water- and sediment-control

basins, diversions, and grade-stabilization structures help to prevent gully erosion.
• Contour farming, contour stripcropping, and terraces reduce the runoff rate and help to control water erosion.
• Properly regulating the application of irrigation water helps to control runoff and water erosion.
• Timing fertilizer applications so that they meet crop nutrient needs, using split fertilizer applications, and applying fertilizer in bands may reduce the risk of nutrient leaching.
• Conservation tillage systems, contour farming, cover crops, and sod-based rotations minimize the detachment and loss of nutrients associated with sediment, thus minimizing the losses of solid-phase nitrogen and phosphorus.
• Using a system of conservation tillage, leaving crop residue on the surface, and adding other organic material conserve moisture.
• Drought-tolerant crops should be selected for planting.
• Cobblestones in the surface layer interfere with the use of tillage, planting, and some harvesting equipment. Removing the cobblestones reduces wear on equipment.

Pasture
Major management concerns: Low available water capacity, overgrazing
Management measures:
• Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: None

Buildings
Major management concerns: Slope, cutbanks cave
Management measures:
• Some land grading may be needed.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields
Major management concerns: Slope, poor filter
Management measures:
• Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly.
• The poor filtering capacity of this soil can result in the pollution of ground water.

Interpretive Groups

Land capability classification: IIIe
Woodland ordination symbol: 4A
Michigan soil management group: Ga

44D2—Leoni very gravelly sandy loam, 12 to 18 percent slopes, eroded

Setting

Landform: Outwash plains, kames
Position on the landform: Back slopes
Distinctive landscape features: Eroded surface
Shape of areas: Irregular, oval
Size of areas: 5 to 120 acres

Typical Profile

Surface layer:
0 to 8 inches—dark brown very gravelly sandy loam
Subsoil:
8 to 18 inches—brown, firm very gravelly clay loam
18 to 30 inches—brown, friable extremely gravelly sandy loam
30 to 42 inches—dark brown, very friable extremely gravelly loamy sand and yellowish brown gravelly coarse sand
Substratum:
42 to 60 inches—yellowish brown gravelly coarse sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate in the upper part, rapid in the lower part
Available water capacity: Low
Drainage class: Well drained
Depth to the water table: Greater than 6 feet
Surface runoff: Rapid
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Severe
Hazard of wind erosion: Slight
Shrink-swell potential: Low

Composition

Leoni soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The well drained, sandy Spinks soils in landscape positions similar to those of the Leoni soil
• The well drained Boyer soils, which have less clay in the subsoil than the Leoni soil; in landscape positions similar to those of the Leoni soil
Similar inclusions:
• Soils that have less than 35 percent rock fragments in the subsoil
• Areas that are not eroded

Use and Management

Land use: Dominant use—pasture; other uses—cropland, woodland, building sites

Cropland

Major management concerns: Water erosion, low available water capacity, nutrient loss, equipment limitations associated with a high cobble content

Management measures:

• Conservation tillage and crop rotations that include grasses or legumes, conservation tillage, and cover crops help to control water erosion.

• Grassed waterways, water- and sediment-control basins, diversions, and grade-stabilization structures help to prevent gully erosion.

• Contour farming, contour stripcropping, and terraces reduce the runoff rate and help to control water erosion.

• Growing grasses and legumes for pasture or hay is effective in controlling erosion.

• Timing fertilizer applications so that they meet crop nutrient needs, using split fertilizer applications, and applying fertilizer in bands may reduce the risk of nutrient leaching.

• Conservation tillage systems, contour farming, cover crops, and sod-based rotations minimize the detachment and loss of nutrients associated with sediment, thus minimizing the losses of solid-phase nitrogen and phosphorus.

• Using a system of conservation tillage, leaving crop residue on the surface, and adding other organic material conserve moisture.

• Drought-tolerant crops should be selected for planting.

• Cobblestones in the surface layer interfere with the use of tillage, planting, and some harvesting equipment. Removing the cobblestones reduces wear on equipment.

• Drought-tolerant crops should be selected for planting.

• Because of the risk of ground-water pollution, nutrients in manure and fertilizer applications should not exceed the requirements of the plants.

Pasture

Major management concerns: Low available water capacity, overgrazing

Management measures:

• Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.

• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: None

Buildings

Major management concerns: Slope, cutbanks cave

Management measures:

• Buildings should be designed so that they conform to the natural slope of the land. Land shaping is necessary in some areas.

• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Slope, poor filter

Management measures:

• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

• The poor filtering capacity of this soil can result in the pollution of ground water.

Interpretive Groups

Land capability classification: IVe
Woodland ordination symbol: 4A
Michigan soil management group: Ga

45—Napoleon muck, ponded

Setting

Landform: Ground moraines, end moraines, lake plains
Position on the landform: Shallow closed depressions
Shape of areas: Irregular
Size of areas: 5 to 60 acres

Typical Profile

Surface layer:
0 to 14 inches—black muck

Subsoil:
14 to 37 inches—very dark brown, friable mucky peat
37 to 48 inches—very dark brown, friable peat

Substratum:
48 to 60 inches—black mucky peat

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate
Available water capacity: Very high
Drainage class: Very poorly drained
Seasonal high water table: 1 foot below to 1 foot above the surface from September through June
Surface runoff: Ponded
Flooding: None
Organic matter content: Very high
Hazard of water erosion: Slight
Hazard of wind erosion: Slight

Composition

Napoleon soil and similar soils: 95 to 100 percent
Contrasting inclusions: 0 to 5 percent

Inclusions

Contrasting inclusions:
• The very poorly drained, mineral Wolcott soils and the poorly drained Gilford soils in landscape positions similar to those of the Napoleon soil

Similar inclusions:
• Organic soils that have sandy or loamy material above a depth of 51 inches

Use and Management

Land use: Dominant use—wildlife habitat; other uses—cropland, pasture

Cropland
Major management concerns: Seasonal wetness, wind erosion, ponding, subsidence, high acidity
Management measures:
• Conservation tillage, vegetative barriers, and cover crops help to control wind erosion.
• Cultivated crops are not commonly grown because of the ponding and the high acidity of the soil. Overcoming these limitations is generally impractical.
• Specialty crops, such as blueberries and cranberries, can be grown.
• Excess water can be removed by open ditches, subsurface drains, surface drains, pumps, or a combination of these.
• Measures that control the water table help to prevent an excessive rate of subsidence. Overdrainage increases the rate.

Pasture
Major management concerns: Compaction, seasonal wetness
Management measures:
• Hay and pasture plants that can withstand periodic inundation and seasonal wetness should be seeded.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.

Woodland
Major management concerns: Equipment limitations, seedling mortality, windthrow hazard
Management measures:
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Special harvesting equipment is needed. The equipment can be used only during periods in winter when skid roads and access roads are frozen.
• Because of wetness, severe seedling mortality, and plant competition, trees are generally not planted on this soil.
• Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by such harvest methods as selective cutting and strip cutting.

Interpretive Groups

Land capability classification: VIw
Woodland ordination symbol: 2W
Michigan soil management group: Mc-a

46—Wallkill silt loam

Setting

Landform: End moraines, ground moraines
Position on the landform: Depressions
Shape of areas: Irregular
Size of areas: 5 to 15 acres

Typical Profile

Surface layer:
0 to 6 inches—very dark brown silt loam

Subsoil:
6 to 25 inches—dark grayish brown, mottled, friable silt loam

Substratum:
25 to 34 inches—grayish brown, mottled silt loam
34 to 49 inches—black muck
49 to 60 inches—very dark brown mucky peat

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate in the upper part, moderately slow to moderately rapid in the lower part
Available water capacity: High
Drainage class: Very poorly drained
Seasonal high water table: 0.5 foot above to 1.0 foot below the surface from September through June
Surface runoff: Very slow or ponded
Flooding: None
Organic matter content: Very high
Hazard of water erosion: Slight
Hazard of wind erosion: Slight
Shrink-swell potential: Low

Composition

Wallkill soil and similar soils: 95 to 100 percent
Contrasting inclusions: 0 to 5 percent

Inclusions

Contrasting inclusions:
• The very poorly drained Wolcott and poorly drained Pewamo soils, which do not contain organic bands; in landscape positions similar to those of the Wallkill soil
• The very poorly drained Houghton soils in the center of the unit

Similar inclusions:
• Soils that have less than 20 inches of loamy material over muck

Use and Management

Land use: Dominant use—woodland; other uses—cropland, pasture

Cropland
Major management concerns: Seasonal wetness, ponding
Management measures:
• Most climatically adapted crops can be grown if an adequate drainage system is installed.
• Excess water can be removed by open ditches, subsurface drains, surface drains, pumps, or a combination of these.

Pasture
Major management concerns: Compaction, seasonal wetness
Management measures:
• Hay and pasture plants that can withstand periodic inundation and seasonal wetness should be seeded.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.

Woodland
Major management concerns: Equipment limitations, seedling mortality, windthrow hazard
Management measures:
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Special harvesting equipment is needed. The equipment can be used only during periods in winter when skid roads and access roads are frozen.
• Because of wetness, severe seedling mortality, and plant competition, trees are generally not planted on this soil.
• Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by such harvest methods as selective cutting and strip cutting.

Interpretive Groups

Land capability classification: Vw
Woodland ordination symbol: 2W
Michigan soil management group: 2c/LA

50B—Coloma sand, 0 to 6 percent slopes

Setting

Landform: Outwash plains
Position on the landform: Broad plains and low knolls
Shape of areas: Irregular
Size of areas: 3 to 250 acres

Typical Profile

Surface layer:
0 to 9 inches—dark grayish brown sand
Subsurface layer:
9 to 35 inches—dark yellowish brown sand
Subsoil:
35 to 60 inches—yellowish brown, loose sand with bands of dark yellowish brown loamy sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Rapid
Available water capacity: Low
Drainage class: Excessively drained
Depth to the water table: Greater than 6 feet
Surface runoff: Very slow
Flooding: None
Organic matter content: Low
Hazard of water erosion: Slight
Hazard of wind erosion: Severe
Shrink-swell potential: Low

Composition

Coloma soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The moderately well drained Glynwood and Williamstown soils, which have more clay throughout than the Coloma soil; in landscape positions similar to those of the Coloma soil
• The somewhat poorly drained Thetford soils in drainageways and on foot slopes
Similar inclusions:
• Soils that have bands more than 6 inches thick in the subsoil
• Soils that have a substratum of stratified sand and gravel
• Areas that are moderately well drained

Use and Management

Land use: Dominant uses—cropland, recreation; other uses—pasture, woodland, building sites

Cropland
Major management concerns: Low available water capacity, wind erosion, organic matter content, nutrient loss
Management measures:
• Conservation tillage, crop residue management, windbreaks, and cover crops help to control wind erosion.
• Timing fertilizer applications so that they meet crop

nutrient needs, using split fertilizer applications, and applying fertilizer in bands may reduce the risk of nutrient leaching.
• Increasing the organic matter content in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and may reduce the risk of ground-water pollution.
• Managing irrigation water reduces the amount of nitrogen leached from irrigated fields.
• Using a system of conservation tillage, leaving crop residue on the surface, and adding other organic material conserve moisture.
• Drought-tolerant crops should be selected for planting, or the soil should be irrigated.
• Keeping crop residue on the surface, regularly adding other organic material, and applying a system of no-till planting increase the organic matter content.

Pasture
Major management concerns: Low available water capacity, overgrazing, wind erosion
Management measures:
• Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: Equipment limitations, seedling mortality
Management measures:
• Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
• Planting seedlings that can withstand droughty conditions can lower the seedling mortality rate. Replanting is needed in some areas.

Buildings
Major management concerns: Cutbanks cave
Management measures:
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields
Major management concerns: Poor filter
Management measures:
• The poor filtering capacity of this soil can result in the pollution of ground water.

Interpretive Groups

Land capability classification: IVs
Woodland ordination symbol: 2S
Michigan soil management group: 5a

50C—Coloma sand, 6 to 18 percent slopes

Setting

Landform: Outwash plains
Position on the landform: Knolls, foot slopes
Shape of areas: Irregular
Size of areas: 3 to 150 acres

Typical Profile

Surface layer:
0 to 9 inches—dark grayish brown sand

Subsurface layer:
9 to 35 inches—dark yellowish brown sand

Subsoil:
35 to 60 inches—yellowish brown, loose sand with bands of dark yellowish brown loamy sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Rapid
Available water capacity: Low
Drainage class: Excessively drained
Depth to the water table: Greater than 6 feet
Surface runoff: Slow
Flooding: None
Organic matter content: Low
Hazard of water erosion: Slight
Hazard of wind erosion: Severe
Shrink-swell potential: Low

Composition

Coloma soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The well drained Morley and Miami soils, which have more clay throughout than the Coloma soil; in landscape positions similar to those of the Coloma soil
• The somewhat poorly drained Thetford soils in drainageways and on foot slopes

Similar inclusions:
• Soils that have bands more than 6 inches thick in the subsoil
• Soils that have a substratum of stratified sand and gravel

Use and Management

Land use: Dominant uses—pasture, recreation; other uses—cropland, woodland, building sites

Cropland
Major management concerns: Low available water capacity, wind erosion, organic matter content, nutrient loss

Management measures:
• Conservation tillage, crop residue management, windbreaks, and cover crops help to control wind erosion.
• Timing fertilizer applications so that they meet crop nutrient needs, using split fertilizer applications, and applying fertilizer in bands may reduce the risk of nutrient leaching.
• Increasing the organic matter content in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and may reduce the risk of ground-water pollution.
• Using a system of conservation tillage, leaving crop residue on the surface, and adding other organic material conserve moisture.
• Drought-tolerant crops should be selected for planting.
• Keeping crop residue on the surface, regularly adding other organic material, and applying a system of no-till planting increase the organic matter content.

Pasture
Major management concerns: Low available water capacity, overgrazing, wind erosion
Management measures:
• Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: Equipment limitations, seedling mortality
Management measures:
• Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
• Planting seedlings that can withstand droughty conditions can lower the seedling mortality rate. Replanting is needed in some areas.

Buildings
Major management concerns: Slope, cutbanks cave
Management measures:
• Buildings should be designed so that they conform to the natural slope of the land. Land shaping is necessary in some areas.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields
Major management concerns: Slope, poor filter
Management measures:
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.
• The poor filtering capacity of this soil can result in the pollution of ground water.

Interpretive Groups

Land capability classification: VIs
Woodland ordination symbol: 2S
Michigan soil management group: 5a

50E—Coloma sand, 18 to 35 percent slopes

Setting

Landform: Outwash plains
Position on the landform: Shoulder slopes and ridges
Shape of areas: Irregular, linear
Size of areas: 3 to 150 acres

Typical Profile

Surface layer:
0 to 9 inches—dark grayish brown sand
Subsurface layer:
9 to 35 inches—dark yellowish brown sand
Subsoil:
35 to 60 inches—yellowish brown, loose sand with bands of dark yellowish brown loamy sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Rapid
Available water capacity: Low
Drainage class: Excessively drained
Depth to the water table: Greater than 6 feet
Surface runoff: Moderate
Flooding: None
Organic matter content: Low
Hazard of water erosion: Moderate
Hazard of wind erosion: Severe
Shrink-swell potential: Low

Composition

Coloma soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The well drained Morley and Miami soils, which have more clay throughout than the Coloma soil; in landscape positions similar to those of the Coloma soil
• The somewhat poorly drained Thetford soils in drainageways and on foot slopes
Similar inclusions:
• Soils that have bands more than 6 inches thick in the subsoil
• Soils that have a substratum of stratified sand and gravel

Use and Management

Land use: Dominant use—woodland; other use—pasture

Cropland

Major management concerns: Slope, low available water capacity, wind erosion, organic matter content, nutrient loss

Management measures:

• Because of the slope, this soil is very difficult to manage and is generally not used for cultivated crops.

Pasture

Major management concerns: Low available water capacity, overgrazing, wind erosion

Management measures:

• Growing grasses and legumes for pasture or hay is effective in controlling erosion.

• Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.

• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland

Major management concerns: Equipment limitations, erosion hazard, seedling mortality

Management measures:

• Because loose sand and the slope can hinder the traction of wheeled equipment, skid roads should be built on the contour or on the gentler slopes.

• Planting seedlings that can withstand droughty conditions can lower the seedling mortality rate. Replanting is needed in some areas.

Buildings

Major management concerns: Slope, cutbanks cave

Management measures:

• Because of the slope, this soil is poorly suited to building site development unless extensive land shaping is applied.

• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Slope

Management measures:

• Because of the slope, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: VIIs

Woodland ordination symbol: 2R

Michigan soil management group: 5a

51—Glendora mucky loamy sand, frequently flooded

Setting

Landform: First-bottom flood plains

Position on the landform: Natural levees

Shape of areas: Linear

Size of areas: 5 to 250 acres

Typical Profile

Surface layer:

0 to 16 inches—black mucky loamy sand

Substratum:

16 to 20 inches—pale brown, mottled sand with bands of black organic material

20 to 36 inches—yellowish brown, mottled sand with bands of black organic material

36 to 60 inches—dark grayish brown sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Rapid

Available water capacity: Low

Drainage class: Very poorly drained

Seasonal high water table: Near the surface to 1 foot below the surface from November through June

Surface runoff: Very slow

Flooding: Frequent

Organic matter content: High

Hazard of water erosion: Slight

Hazard of wind erosion: Moderate

Shrink-swell potential: Low

Composition

Glendora soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

• The very poorly drained, organic Houghton soils in depressions

Similar inclusions:

• Soils that have a surface layer of loamy sand

• Soils that have a mucky surface layer

Use and Management

Land use: Dominant use—cropland; other uses—woodland, pasture

Cropland

Major management concerns: Seasonal wetness, flooding, low available water capacity, wind erosion

Management measures:

• Conservation tillage and cover crops help to control wind erosion.

• Most climatically adapted crops can be grown if an

adequate drainage system is installed and flooding is controlled.
• Improving drainage is difficult because most areas are seasonally flooded and have poor outlets.
• Overdrainage can result in droughtiness.
• Using a system of conservation tillage, leaving crop residue on the surface, and adding other organic material conserve moisture.
• If a good surface drainage system is installed, late-planted crops can be grown after the normal flooding period.

Pasture
Major management concerns: Compaction, flooding, seasonal wetness
Management measures:
• Hay and pasture plants that can withstand periodic inundation and seasonal wetness should be seeded.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants.

Woodland
Major management concerns: Equipment limitations, seedling mortality, windthrow hazard
Management measures:
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
• Because of wetness, severe seedling mortality, and plant competition, trees are generally not planted on this soil.
• Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by such harvest methods as selective cutting and strip cutting.

Buildings
Major management concerns: Flooding, seasonal high water table, cutbanks cave
Management measures:
• Alternative sites should be selected.

Septic tank absorption fields
Major management concerns: Flooding, seasonal high water table
Management measures:
• Alternative sites should be selected.

Interpretive Groups

Land capability classification: VIw
Woodland ordination symbol: 3W
Michigan soil management group: L-4c

55—Pits, gravel

Setting

Landform: Outwash plains, kames
Position on the landform: Manmade depressions
Shape of areas: Irregular
Size of areas: 3 to 320 acres

Composition

Pits: 100 percent

Use and Management

Land use: Source of gravel
Management measures:
• Onsite investigation is needed to determine the suitability for specific uses.

Interpretive Groups

Land capability classification: None
Woodland ordination symbol: None
Michigan soil management group: None

57—Shoals loam, occasionally flooded

Setting

Landform: Second-bottom flood plains
Position on the landform: Narrow stream valleys, slight depressions
Shape of areas: Linear
Size of areas: 5 to 50 acres

Typical Profile

Surface layer:
0 to 8 inches—dark grayish brown loam
Substratum:
8 to 18 inches—brown, mottled silt loam
18 to 49 inches—grayish brown, mottled silt loam and fine sandy loam
49 to 60 inches—gray, mottled fine sandy loam with bands of very dark brown organic material ½ inch thick

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate
Available water capacity: High
Drainage class: Somewhat poorly drained
Seasonal high water table: At a depth of 0.5 foot to 1.5 feet from January through April
Surface runoff: Slow
Flooding: Occasional
Organic matter content: Moderate

Hazard of water erosion: Slight
Hazard of wind erosion: Slight
Shrink-swell potential: Low

Composition

Shoals soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:
• The very poorly drained Sloan soils in the slightly lower positions on the landscape

Similar inclusions:
• Small areas of moderately well drained soils on second bottoms

Use and Management

Land use: Dominant use—cropland; other uses—pasture, woodland

Cropland
Major management concerns: Seasonal wetness, flooding, soil compaction, soil tilth
Management measures:
• Most climatically adapted crops can be grown if an adequate drainage system is installed and flooding is controlled.
• Improving drainage is difficult because most areas are seasonally flooded and have poor outlets.
• Crop residue management, green manure crops, applications of manure, cover crops, conservation tillage, and a cropping sequence that includes grasses and legumes maintain or improve tilth and increase the available water capacity and the organic matter content.
• Minimizing tillage and tilling and harvesting at the proper soil moisture content help to prevent excessive compaction and maintain tilth.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, water infiltration, and permeability.
• If a good surface drainage system is installed, late-planted crops can be grown after the normal flooding period.

Pasture
Major management concerns: Compaction, flooding, seasonal wetness
Management measures:
• Proper stocking rates, a planned grazing system, and deferred grazing during wet periods help to keep the pasture in good condition.
• Hay and pasture plants that can withstand periodic inundation and seasonal wetness should be seeded.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants.

Woodland
Major management concerns: Equipment limitation, seedling mortality
Management measures:
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Skidders should not be used during wet periods, when ruts form easily.
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.

Buildings
Major management concerns: Wetness
Management measures:
• Alternative sites should be selected.

Septic tank absorption fields
Major management concerns: Flooding
Management measures:
• Alternative sites should be selected.

Interpretive Groups

Land capability classification: IIw
Woodland ordination symbol: 4W
Michigan soil management group: 3.5b

58B—Seward loamy sand, 0 to 4 percent slopes

Setting

Landform: Dunes
Position on the landform: Low knolls
Shape of areas: Irregular
Size of areas: 3 to 30 acres

Typical Profile

Surface layer:
0 to 8 inches—dark brown loamy sand

Subsoil:
8 to 17 inches—yellowish brown, loose loamy sand
17 to 35 inches—yellowish brown and brown, mottled, very friable loose sand
35 to 40 inches—dark yellowish brown, mottled, friable sandy loam

Substratum:
40 to 60 inches—brown silty clay loam

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderately rapid in the upper part, slow in the lower part
Available water capacity: Moderate
Drainage class: Moderately well drained
Seasonal high water table: At a depth of 1.5 to 3.5 feet from January through April
Surface runoff: Slow
Flooding: None
Organic matter content: Moderate
Hazard of water erosion: Slight
Hazard of wind erosion: Moderate
Shrink-swell potential: Low

Composition

Seward soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
• The well drained Fox and Spinks soils in the slightly higher positions on the landscape
• The moderately well drained Williamstown and Glynwood soils, which have more clay in the upper part of the subsoil than the Seward soil; in landscape positions similar to those of the Seward soil
• The somewhat poorly drained Blount soils in the slightly lower positions on the landscape

Use and Management

Land use: Dominant use—cropland; other uses—pasture, woodland, building sites

Cropland
Major management concerns: Low available water capacity, wind erosion
Management measures:
• Conservation tillage and cover crops help to control wind erosion.
• Timing fertilizer applications so that they meet crop nutrient needs, using split fertilizer applications, and applying fertilizer in bands may reduce the risk of nutrient leaching.
• Increasing the organic matter content in the root zone may increase the ability of the soil to hold water, nutrients, and pesticides and may reduce the risk of ground-water pollution.
• Managing irrigation water reduces the amount of nitrogen leached from irrigated fields.
• Using a system of conservation tillage, leaving crop residue on the surface, and adding other organic material conserve moisture.
• Drought-tolerant crops should be selected for planting, or the soil should be irrigated.

Pasture
Major management concerns: Low available water capacity, overgrazing
Management measures:
• Proper stocking rates, controlled grazing, rotation grazing, and restricted use during dry periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

Woodland
Major management concerns: Seedling mortality
Management measures:
• Planting seedlings that can withstand droughty conditions can lower the seedling mortality rate. Replanting is needed in some areas.

Buildings
Major management concerns: Wetness, cutbanks cave
Management measures:
• Constructing buildings on well compacted fill material raises the site a sufficient distance above the water table.
• Wetness can be reduced by installing a drainage system around structures with basements and crawl spaces.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields
Major management concerns: Wetness, slow permeability
Management measures:
• Filling or mounding with suitable material helps to raise the absorption field above the water table.
• Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.

Interpretive Groups

Land capability classification: IIs
Woodland ordination symbol: 4S
Michigan soil management group: 4/1a

Prime Farmland

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

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it

is not urban or built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Natural Resources Conservation Service.

About 211,800 acres in the survey area, or about 54 percent of the total acreage, meets the soil requirements for prime farmland. This land is distributed evenly throughout the county in areas of associations 1, 2, 3, 4, and 5, which are described under the heading "General Soil Map Units." About 170,000 acres of this prime farmland is used for crops. The crops grown on this land, mainly corn, soybeans, winter wheat, and oats, account for an estimated two-thirds of the county's total agricultural income each year.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table and all soils that are frequently flooded during the growing season qualify as prime farmland only in areas where these limitations have been overcome by drainage measures or flood control. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not these limitations have been overcome by corrective measures.

Use and Management of the Soils

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

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

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

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

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

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

Crops and Pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Natural Resources Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

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

In 1987, approximately 196,210 acres was used for crops and pasture in Hillsdale County. About 90,400 acres was used for corn. Of this total, about 7,500 acres was harvested for silage. About 42,000 acres was used for soybeans, about 12,000 acres for wheat, and about 6,200 acres for oats. About 23,500 acres was used for hay. The rest of the acreage was used for pasture (Michigan Department of Agriculture, 1988). A number of specialty crops were also grown. The most common of these were apples, sweet corn, pickles, and tomatoes.

Corn, wheat, soybeans, and oats are the commonly grown crops that are suited to the soils and climate of the survey area. Grain sorghum and sunflowers can also be grown if economic conditions are favorable. Rye, buckwheat, and barley are close-growing crops that have good potential. Grass seed can be produced from brome, fescue, red clover, redtop, and bluegrass. Alfalfa and clover grown in mixtures with grasses are the most common hay crops.

The production of food could be increased in the county by applying soil and water conservation practices and by extending the latest crop production technology to the soils best suited to crops. The major management concerns in the areas used for crops and pasture are water erosion, wind erosion, droughtiness, wetness, fertility, and compaction.

Water erosion is a major hazard on about 47 percent of the cropland in Hillsdale County. The erodibility of the soil is dependent upon the slope gradient, the length of the slope, and the texture of the surface layer. If slopes

are more than about 2 percent, water erosion is a hazard, especially in areas where the slopes are more than 400 feet long. Clayey, silty, and loamy soils are more susceptible to water erosion than sandy soils. In Hillsdale County, the soils that are most susceptible to water erosion are Fox sandy loam, Glynwood loam, Hillsdale sandy loam, Miami loam, Miami clay loam, Morley loam, Morley clay loam, Riddles sandy loam, and Williamstown loam.

Loss of the surface layer through erosion reduces the productivity of soils and results in the sedimentation of lakes, streams, and ditches. As the topsoil is removed, organic matter is lost and clay from the subsoil is incorporated into the plow layer. As a result, the quality of the seedbed is reduced, the plants become stunted, the seedling mortality rate increases, and further erosion is likely. Also, the fertilizer and agricultural chemicals attached to the soil particles are deposited in surface water, reducing the quality of the water.

Erosion-control practices reduce the length of slopes, minimize the detachment of soil particles caused by the impact of raindrops, reduce the runoff rate, and increase the rate of water infiltration. Including forage crops of grasses and legumes in the cropping sequence results in excellent vegetative cover. The grasses and legumes also provide nitrogen for subsequent crops, minimize surface compaction, and improve tilth. Diversions, terraces, water- and sediment-control basins, contour farming, and contour stripcropping help to control water erosion by reducing the length of slopes. Conservation tillage helps to control surface runoff and sheet erosion. Systems of conservation tillage used in Hillsdale County include chisel-disk, plow-plant, strip-till, no-till, and ridge-till. Grassed waterways help to control gully erosion.

Wind erosion is a hazard in areas of soils in which the surface layer has weak aggregate stability. The sandy Coloma soils are examples. Soils that have a surface layer of loamy sand or sandy loam, such as Boyer, Eleva, Fox, Hillsdale, Riddles, Spinks, Steamburg, and Thetford soils, are also susceptible to wind erosion. In areas where they are artificially drained, the mucky Adrian, Edwards, Houghton, and Palms soils are also susceptible. Some of the loamy soils are also susceptible to wind erosion unless proper management is applied. Maintaining an adequate plant cover or surface mulch helps to control wind erosion. Wind erosion can also be controlled with properly designed buffer strips and with windbreaks planted at right angles to the prevailing winds.

Soil wetness is a major management concern on about 36 percent of the cropland in the county. Drainage of cropland improves soil temperature and the air-water relationship in the root zone. In areas were drainage is limited, spring planting, spraying, and harvesting are delayed and weed control is difficult. Properly designed tile drains, surface drains, or both can be used to remove excess water.

Some soils are naturally so wet that they cannot be used for the crops commonly grown in the county. Unless an artificial drainage system is installed, very poorly drained, poorly drained, and somewhat poorly drained soils are so wet that crops either cannot be planted or are damaged in most years. Examples are Blount, Conover, Gilford, Locke, Matherton, Pewamo, Sebewa, and Wolcott soils.

The design of subsurface and surface drainage systems is determined by soil properties, such as texture, structure, and slope. A combination of surface and subsurface drains is needed in all areas of poorly drained and very poorly drained soils that are intensively row cropped. The drains should be more closely spaced in areas of slowly permeable soils, such as Blount soils, than in areas of the more permeable soils. Finding adequate outlets for tile drainage systems is difficult in many areas of Adrian, Edwards, Glendora, Houghton, Palms, Sebewa, and Sloan soils because of flat grades. Pumping systems can be used in these areas. Diversions may be needed in areas that receive runoff from the higher slopes. Good tilth, an ample supply of organic matter, and good subsoil structure improve internal drainage. Most of the soils that require drainage are in low areas where the growing season is shortened by frost late in spring and early in fall. Water-logged soils retain the low soil temperature of the soil water until late into spring. Drainage can extend the growing season and increase plant growth by helping the soils to warm more quickly in spring.

Organic soils oxidize and subside when their pore space is filled with air. As a result, special systems are needed to control the depth and the period of drainage. Maintaining the water table at the level required by the crops during the growing season and raising it to the surface during the other parts of the year minimize the oxidation and subsidence of these soils.

Care is needed to prevent the drainage of designated wetlands. Such drainage could violate existing wetland laws and regulations.

Information about the design of drainage systems for each kind of soil is available in the field office technical guide, which is available in the local office of the Natural Resources Conservation Service.

Low available water capacity is a limitation in areas of Coloma, Boyer, Eleva, Fox, Leoni, and Spinks soils. Available water capacity can be improved by increasing the content of organic matter. Crop production can be improved by applying an irrigation system in areas of these soils. Irrigation is especially helpful for specialty

crops, such as orchard crops and vegetables. Irrigation is feasible in areas where manmade ponds, surface water, or subsurface water is abundant and a suitable source of water and in areas where the soils have a good intake rate. Conservation tillage, grassed waterways, and proper management of irrigation water are needed to control runoff and erosion and to maintain an efficient irrigation system. Tailwater recovery may be necessary to control offsite damage.

Soil fertility is naturally low or medium in loamy soils and is naturally low in sandy soils. Many sandy soils are naturally medium acid or slightly acid. Applications of lime or marl are needed to raise the pH level of the plow layer sufficiently for the good establishment and growth of alfalfa and other crops that grow best at a pH level near neutral. On all soils, additions of fertilizer and lime should be based on the results of soil tests, on the needs of the crop, and on reasonable yields goals. The Cooperative Extension Service can help in recommending the proper amounts and kinds of fertilizer to be used (Michigan State University, 1976).

Soil tilth is an important factor affecting the germination of seeds and the infiltration of water into the soil. Soils that have good tilth are friable and have granular structure. Some of the soils used for crops, particularly soils in eroded areas, have a surface layer that is light in color and low in content of organic matter. Generally, the structure of such soils is weak and intensive rainfall causes the surface to crust. This crust increases the runoff rate and the hazard of erosion and inhibits seedling emergence. Regular additions of crop residue, manure, and other organic material improve tilth and help to prevent surface crusting. No-till farming improves the rate of water infiltration by preventing the destruction of worm channels and cracks in the natural soil structure.

Soil compaction is the result of using equipment or allowing heavy animals to graze when the soil is wet. Preventing soil compaction in loamy and clayey soils is difficult. These soils stay wet until late in the spring. If they are tilled when wet, both the surface layer and the upper part of the subsoil can become compacted. The soils then become cloddy when they dry. Compacted areas have a high runoff rate, poor germination, and very irregular growth of crop plants. Cropping systems that include a controlled traffic pattern, such as ridge-till or strip-till, help to minimize surface compaction. Tilling at the proper soil moisture content is important. Including deep-rooted legumes in the crop rotation and subsoiling when the subsoil is at the proper moisture level help to break apart a plowpan. Over time, a no-till planting system will also degrade a plowpan.

Pasture in the county is generally in areas where erosion is a severe hazard or where the soils are too wet for cultivation. The key forage species include alfalfa and smooth bromegrass on medium textured, well drained soils; alfalfa, red clover, bromegrass, and orchardgrass on coarse textured soils; birdsfoot trefoil and bromegrass on wet soils; and reed canarygrass on undrained mucks.

Control of erosion is particularly important when a pasture is seeded. Mulch seeding or nurse crops help to control erosion. The amount of lime and fertilizer to be applied should be determined by a soil test. Grazing during wet periods results in compaction, which retards the growth of pasture plants. Proper grazing methods, such as deferring grazing until pasture plants are firmly established, increase plant growth and minimize compaction.

The productivity of a pasture and its ability to protect the soil surface are influenced by the number of livestock that the pasture supports, the length of time that they graze, and the distribution of rainfall. Good pasture management includes stocking rates that maintain key forage species, pasture rotation, deferred grazing, and proper placement of water and salt supplies for livestock.

Yields per Acre

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

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

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

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

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

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

Land Capability Classification

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

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit (USDA, 1961). Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

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

Class I soils have few limitations that restrict their use.

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

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

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

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

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

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

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

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

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

The acreage of soils in each capability class and subclass is shown in table 7. The capability classification of the map units in this survey area is given in the section "Detailed Soil Map Units" and in the yields table.

At the end of each map unit description under the heading "Detailed Soil Map Units," the Michigan soil management group is listed. The soils in each map unit are assigned to a group according to the dominant texture, the drainage class, and the main management concerns (Mokma and others, 1978). More detailed information about these groups is available from the local office of the Michigan State University Cooperative Extension Service.

Woodland Management and Productivity

Virgin forest once covered most of Hillsdale County. Presently, about 52,100 acres, or 13 percent of the total acreage, is wooded (USDA, 1982). Areas that have not been cleared for agriculture, such as excessively wet areas, steep areas, or sand dunes, support a variety of forest species, mostly maple, oak, hickory, ash, cherry, poplar, pine, and walnut. If these areas are used for timber production, they can benefit from management measures that improve the timber stands. Such measures include thinning; selective harvesting; replanting; and controlling plant competition, insects, and disease. In some places, planting high value hardwoods or pines in areas of marginal value for crops can be economical. The Natural Resources

Conservation Service and the Michigan Department of Natural Resources, Division of Forestry, can help to determine specific management needs.

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

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The number 1 indicates low potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; *F*, a high content of rock fragments in the soil; and *N*, snowpack. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, F, and N.

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

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, and fire lanes and in log-handling areas. Forests that have been burned or overgrazed are also subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment and season of use are not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

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

The *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand. The volume is determined through

the use of standard yield tables as referenced in the National Forestry Manual (USDA/NRCS).

The first species listed under *common trees* for a soil is the indicator species for that soil. It generally is the most common species on the soil and is the one that determines the ordination class.

Trees to plant are those that are suitable for commercial wood production.

Windbreaks and Environmental Plantings

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

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

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

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

Recreation

About 52,100 acres of forest land, 42 inland lakes, and many rivers and streams provide numerous opportunities for recreation in Hillsdale County.

The county has 15 major streams and rivers, 4,275 acres of inland lakes, and 2,300 acres of state-owned lands suitable for fishing, hunting, boating, camping, picnicking, hiking, and swimming. Public lands available for recreation include the Lost Nations State Game Area, Hillsdale Memorial Park on Baw Beese Lake, Lewis Emery Park, Slaton Arboretum, and 22 public access sites on the inland lakes. Other recreational areas include 17 county, city, and township parks, 5 golf courses, and 10 private campgrounds (Freidhoff, 1968; Hillsdale Chamber of Commerce).

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

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

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

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

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

Playgrounds require soils that can withstand intensive

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

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

Wildlife Habitat

Hillsdale County is home to a large variety of wildlife. A heavily wooded state game area provides important habitat for whitetail deer and wild turkey. This area also provides food and cover for various other game and nongame wildlife species, such as raccoons, skunks, tree squirrels, cardinals, wrens, woodpeckers, and mice. The wetlands in the county enhance several migration corridors. The species using these corridors are diving ducks, dabbling ducks, and Canada geese. The wetlands and adjacent areas also provide habitat for herons, cranes, kingfishers, woodcock, marsh hawks, muskrats, and mink. The farmed areas and the associated idle areas of grass and brush are inhabited by pheasants, quail, cottontail rabbits, woodchucks, red fox, gray fox, opossum, hawks, owls, and songbirds. The streams and lakes provide habitat for sunfish, perch, bass, northern pike, bullhead, sucker, and carp (Freidhoff, 1968).

In many areas of the county, the wildlife habitat can be improved. Increasing the acreage of grassland and cropland in areas where more than 50 percent of the vegetation is forest and brush cover would provide more food, cover, and living space. Maintaining the diversity of successional stages of forested land in the Lost Nations State Game Area can protect its value as wildlife habitat.

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

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

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

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

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

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

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

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone,

available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

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

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

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

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

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

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

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

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

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

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

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

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

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

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

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

Building Site Development

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

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

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

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

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

Sanitary Facilities

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

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

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil

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

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

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

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

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

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

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

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

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

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

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

Construction Materials

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Water Management

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

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

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

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

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

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

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

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

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

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

Soil Properties

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

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

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

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

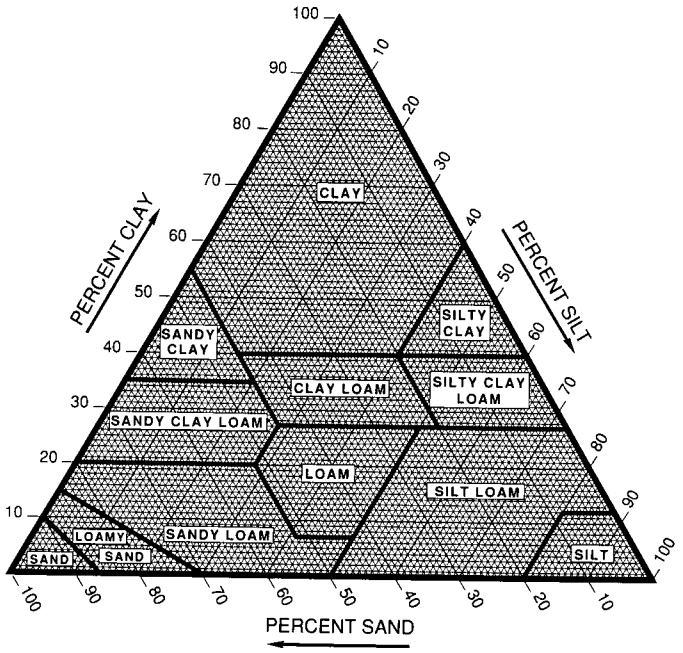

Figure 7.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

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

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

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 7). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (ASTM, 1993) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 1986).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and

clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

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

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

Rock fragments 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

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

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

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

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

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

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

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

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

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

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

fertility and stabilization, and in determining the risk of corrosion.

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

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

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

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

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

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

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.
3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.
5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.
6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.
7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.
8. Soils that are not subject to wind erosion because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 17, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

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

Soil and Water Features

Tables 18 and 19 give estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are listed in table 18. They are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained

sands or gravelly sands. These soils have a high rate of water transmission.

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

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

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

If a soil is assigned to two hydrologic groups in table 18, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

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

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year). Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

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

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

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

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

In table 19, *depth to bedrock* is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence generally results from either desiccation and shrinkage or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. Table 19 shows the expected initial subsidence, which usually is a result of drainage, and total subsidence, which results from a combination of factors.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and

is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

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

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

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

Characterization Data for Selected Soils

Some of the major soils in Hillsdale County were sampled by the National Soil Survey Laboratory in Lincoln, Nebraska. The laboratory data obtained from the soil samples include analysis of particle-size distribution, calcium carbonate equivalent, and clay mineralogy. Standard National Cooperative Soil Survey procedures were used for all analyses.

These data were used in classifying and correlating the soils and in evaluating their behavior. Six profiles were selected as representative of their respective series. These series and their laboratory identification numbers are as follows: Glynwood (S89-MI-059-001, S89-MI-059-006), Locke (S88-MI-059-001), Miami (S88-MI-059-003, S89-MI-059-007, S89-MI-059-010), Morley (S88-MI-059-002), Riddles (S89-MI-059-008), and Williamstown (S89-MI-059-002, S89-MI-059-003, S89-MI-059-004, S89-MI-059-005, S89-MI-059-011).

In addition to the Hillsdale County data, soil characterization data is available from nearby counties having many of the same soils as Hillsdale County. These data and Hillsdale County data are available at the Soils Research Laboratory, Michigan Technological University; the Soil and Water Conservation Division, Michigan Department of Agriculture, Lansing Michigan; and the State office of the Natural Resources Conservation Service, East Lansing, Michigan.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (USDA, 1975). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 20 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

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

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

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Ochraqualfs (*Ochr*, meaning pale, plus *aqualf*, the suborder of the Alfisols that has an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. An example is Aeric Ochraqualfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine, illitic, mesic Aeric Ochraqualfs.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

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

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" (USDA, 1993). Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" (USDA, 1975). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Adrian Series

The Adrian series consists of very deep, very poorly drained soils in depressions on outwash plains, lake plains, and flood plains. These soils formed in organic material and sandy outwash. Permeability is moderately slow to moderately rapid in the organic material and

rapid in the sandy material. Slopes range from 0 to 2 percent.

Typical pedon of Adrian muck, 200 feet east and 750 feet north of the southwest corner of sec. 5, T. 5 S., R. 4 W.

Oa1—0 to 7 inches; muck, black (10YR 2/1) broken face and black (N 2/0) rubbed; about 15 percent fiber, less than 5 percent rubbed; weak fine granular structure; friable; fibers are herbaceous; slightly acid; abrupt smooth boundary.

Oa2—7 to 14 inches; muck, black (10YR 2/1) broken face and black (N 2/0) rubbed; about 15 percent fiber, less than 5 percent rubbed; weak medium granular structure; friable; primarily herbaceous fibers; slightly acid; abrupt smooth boundary.

Oa3—14 to 19 inches; muck, black (5YR 2.5/1) broken face and dark reddish brown (5YR 2.5/2) rubbed; about 15 percent fiber, less than 5 percent rubbed; weak thick platy structure; friable; primarily herbaceous fibers; neutral; clear wavy boundary.

Oa4—19 to 26 inches; muck, very dark gray (10YR 3/1) broken face and rubbed; about 10 percent fiber, less than 5 percent rubbed; massive; friable; primarily herbaceous fibers; neutral; abrupt smooth boundary.

2C—26 to 31 inches; very dark grayish brown (10YR 3/2) sand; single grain; loose; neutral; clear smooth boundary.

2Cg—31 to 60 inches; dark gray (N 4/0) sand; single grain; loose; neutral.

The thickness of the organic material ranges from 16 to 51 inches but is dominantly less than 40 inches. The organic material is mainly herbaceous. In some pedons, however, as much as 15 percent of the organic material is woody fragments.

The surface tier has hue of 10YR or is neutral in hue. It has value of 2 and chroma of 0 to 2.

The subsurface tier has hue of 10YR to 5YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2.

The C horizon has hue of 10YR or 2.5Y or is neutral in hue. It has value of 3 or 4 and chroma of 0 to 2. It is dominantly sand, coarse sand, or fine sand. In some pedons, however, it has thin layers of finer textures.

Blount Series

The Blount series consists of very deep, somewhat poorly drained soils on ground moraines. These soils formed in silty and loamy glacial till. Permeability is slow. Slopes range from 0 to 4 percent.

Typical pedon of Blount silt loam, 0 to 4 percent slopes, 250 feet east and 2,000 feet south of the northwest corner of sec. 33, T. 8 S., R. 1 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; moderate medium granular structure; friable; about 3 percent gravel; slightly acid; abrupt smooth boundary.

Bt—9 to 24 inches; brown (10YR 5/3) silty clay loam; common medium distinct yellowish brown (10YR 5/6) and gray (10YR 5/1) mottles; moderate medium angular blocky structure; firm; common faint grayish brown (10YR 5/2) clay films on faces of peds; about 3 percent gravel; slightly acid; clear irregular boundary.

Btk—24 to 32 inches; dark yellowish brown (10YR 4/4) clay loam; many medium distinct yellowish brown (10YR 5/6) and gray (10YR 5/1) mottles; weak medium angular blocky structure; firm; common faint grayish brown (10YR 5/2) clay films on faces of peds; common prominent light gray (10YR 7/1) lime streaks and irregular lime masses; about 3 percent gravel; slightly alkaline; clear smooth boundary.

Bk—32 to 60 inches; dark yellowish brown (10YR 4/4) clay loam; many medium distinct yellowish brown (10YR 5/6) and few medium distinct gray (10YR 5/1) mottles; moderate thick platy structure; firm; common prominent light gray (10YR 7/1) lime coatings on faces of peds and irregular lime masses; about 2 percent gravel; violently effervescent; slightly alkaline.

The thickness of the solum ranges from 25 to more than 60 inches. The depth to free carbonates ranges from 25 to 32 inches. The content of gravel and cobbles ranges from 1 to 5 percent throughout the profile.

The Ap or A horizon has hue of 10YR, value of 3 or 4, and chroma of 2 to 4. It is silt loam.

The B horizon has hue of 10YR, value of 4 or 5, and chroma of 1 to 4. It is clay loam, silty clay loam, or silty clay.

Boyer Series

The Boyer series consists of very deep, well drained soils on outwash plains and river terraces. These soils formed in loamy outwash underlain by sandy or gravelly sand outwash. Permeability is moderately rapid in the upper part and very rapid in the lower part. Slopes range from 1 to 35 percent.

Typical pedon of Boyer loamy sand, 1 to 6 percent slopes, 1,920 feet east and 480 feet north of the southwest corner of sec. 8, T. 7 S., R. 2 W.

Ap—0 to 11 inches; dark brown (10YR 4/3) loamy sand, pale brown (10YR 6/3) dry; moderate medium granular structure; very friable; about 10 percent gravel; slightly acid; abrupt wavy boundary.

E—11 to 16 inches; dark yellowish brown (10YR 4/4) gravelly loamy sand; weak medium subangular blocky structure; very friable; about 20 percent gravel; neutral; clear wavy boundary.

2Bt1—16 to 19 inches; brown (7.5YR 4/4) gravelly sandy loam; moderate medium subangular blocky structure; friable; common faint dark brown (7.5YR 3/4) clay films on faces of peds; about 20 percent gravel; neutral; clear wavy boundary.

2Bt2—19 to 23 inches; dark brown (7.5YR 3/4) gravelly sandy loam; moderate medium subangular blocky structure; friable; common faint dark brown (7.5YR 3/4) clay films on faces of peds and rock fragments; about 25 percent gravel; slightly acid; abrupt wavy boundary.

3BC—23 to 30 inches; strong brown (7.5YR 4/6) loamy sand; weak medium subangular blocky structure; very friable; about 2 percent gravel; neutral; abrupt broken boundary.

3C1—30 to 33 inches; brown (10YR 5/3) coarse sand; single grain; loose; strongly effervescent; slightly alkaline; abrupt irregular boundary.

3C2—33 to 60 inches; dark yellowish brown (10YR 4/4) very gravelly coarse sand; single grain; loose; very few white (10YR 8/2) lime pendants on rock fragments; about 50 percent gravel; violently effervescent; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 24 to 40 inches. The content of gravel ranges from 10 to 25 percent in the solum and from 2 to 50 percent in the 3C horizon.

The Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 2 or 3. Some pedons have an A horizon. This horizon has value of 2. It is loamy sand or gravelly loamy sand.

The E horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. It is loamy sand, gravelly loamy sand, or sandy loam.

The 2Bt horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 4 to 6. It is sandy loam, sandy clay loam, or the gravelly analogs of these textures. The 3BC horizon has colors similar to those of the Bt horizon. It is loamy sand.

The 3C horizon has hue of 10YR, value of 4 to 6, and chroma of 3 or 4. It is coarse sand, sand, gravelly coarse sand, very gravelly coarse sand, gravelly sand, or stratified sand and gravel.

Coloma Series

The Coloma series consists of very deep, excessively drained soils on outwash plains. These soils formed in sandy outwash. Permeability is rapid. Slopes range from 0 to 35 percent.

Typical pedon of Coloma sand, 6 to 18 percent slopes, 3,000 feet east and 1,500 feet south of the northwest corner of sec. 7, T. 7 S., R. 3 W.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) sand, brown (10YR 5/3) dry; weak fine granular structure; very friable; slightly acid; about 5 percent gravel; abrupt wavy boundary.

E—9 to 35 inches; dark yellowish brown (10YR 4/6) sand; single grain; loose; slightly acid; about 5 percent gravel; clear wavy boundary.

E and Bt1—35 to 46 inches; yellowish brown (10YR 5/6) sand (E); lamellae of dark yellowish brown (10YR 4/6) loamy sand (Bt) 1/8 to 3/8 inch thick; single grain; loose; clay bridges between mineral grains; about 7 percent gravel; slightly acid; clear wavy boundary.

E and Bt2—46 to 60 inches; dark yellowish brown (10YR 4/4) sand (E); lamellae of dark yellowish brown (10YR 4/6) loamy sand (Bt) 1/8 to 3/8 inch thick; single grain; loose; clay bridges between mineral grains; about 7 percent gravel; slightly acid.

The content of gravel ranges from 1 to 7 percent throughout the profile.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3.

The E horizon has hue of 10YR and value and chroma of 4 to 6. The A and E horizons are sand.

The Bt part of the E and Bt horizon consists of lamellae that have hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. They are sandy loam or loamy sand. The combined thickness of the lamellae is less than 6 inches within a depth of 60 inches.

Conover Series

The Conover series consists of very deep, somewhat poorly drained soils on end moraines and ground moraines. These soils formed in loamy glacial till. Permeability is moderately slow. Slopes range from 1 to 4 percent.

Typical pedon of Conover loam, in an area of Williamstown-Conover complex, 1 to 6 percent slopes; in an area where the slope is 2 percent; 2,260 feet north and 150 feet west of the southeast corner of sec. 28, T. 6 S., R. 1 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) loam, grayish brown (10YR 5/2) dry; weak medium

subangular blocky structure; firm; black (10YR 2/1) organic coatings on faces of peds; about 3 percent gravel; neutral; clear wavy boundary.

Bt1—9 to 22 inches; dark brown (10YR 4/3) clay loam; common fine distinct yellowish brown (10YR 5/6) and light olive brown (2.5YR 6/2) mottles; moderate medium subangular blocky structure; firm; many medium faint dark grayish brown (10YR 4/2) clay films on faces of peds; about 5 percent gravel; neutral; clear wavy boundary.

Bt2—22 to 27 inches; brown (10YR 5/3) clay loam; many medium distinct grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; many medium faint grayish brown (10YR 5/2) clay films on faces of peds; about 3 percent gravel; neutral; clear wavy boundary.

C—27 to 60 inches; brown (10YR 4/3) loam; many medium faint grayish brown (10YR 5/2) and common fine distinct yellowish brown (10YR 5/6) mottles; massive; firm; greenish gray (5GY 6/1) lime; about 10 percent gravel; slightly effervescent; slightly alkaline.

The thickness of the solum and the depth to free carbonates range from 27 to 40 inches. The content of gravel and cobbles ranges from 1 to 10 percent throughout the profile.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is loam.

The B horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is clay loam, silty clay loam, or loam.

The C horizon has hue of 10YR, value of 4 to 6, and chroma of 2 or 3. It is clay loam or loam.

Edwards Series

The Edwards series consists of very deep, very poorly drained soils in depressions on ground moraines, end moraines, and lake plains. These soils formed in organic material overlying marl. Permeability is moderately slow to moderately rapid. Slopes range from 0 to 2 percent.

Typical pedon of Edwards muck, 560 feet west and 1,320 feet south of the northeast corner of sec. 5, T. 9 S., R. 4 W.

Oa1—0 to 10 inches; muck, black (N 2/0) broken face and rubbed; about 5 percent fiber, less than 3 percent rubbed; herbaceous fibers; moderate fine granular structure; friable; slightly alkaline; gradual wavy boundary.

Oa2—10 to 15 inches; muck, dark brown (7.5YR 3/2) broken face and rubbed; about 10 percent fiber, less than 5 percent rubbed; herbaceous fibers; moderate fine subangular blocky structure; friable; slightly alkaline; gradual wavy boundary.

Oa3—15 to 18 inches; muck, 80 percent dark brown (7.5YR 3/2) broken face and rubbed and 20 percent brown (7.5YR 4/2) broken face and rubbed; about 15 percent fiber, 5 percent rubbed; herbaceous fibers; weak thick platy structure; friable; about 5 percent shell fragments; strongly effervescent; slightly alkaline; abrupt wavy boundary.

2Cg—18 to 60 inches; grayish brown (2.5Y 5/2) marl; few medium prominent yellowish brown (10YR 5/8) mottles; massive; friable; violently effervescent; moderately alkaline.

The organic material ranges from 18 to 35 inches in thickness. It is mainly herbaceous. In some pedons, however, as much as 15 percent of the organic material is woody fragments.

The surface tier has hue of 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 3.

The subsurface tier has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 1 or 2.

The 2Cg horizon has hue of 2.5Y, value of 5 to 7, and chroma of 1 or 2. It is marl. In some pedons it has thin layers of sand.

Eleva Series

The Eleva series consists of moderately deep, somewhat excessively drained soils on bedrock-controlled uplands. These soils formed in sandy and loamy residuum over sandstone. Permeability is moderate. Slopes range from 2 to 25 percent.

Typical pedon of Eleva channery fine sandy loam, 2 to 6 percent slopes, 820 feet west and 2,100 feet north of the southeast corner of sec. 15, T. 5 S., R. 2 W.

Ap—0 to 6 inches; dark yellowish brown (10YR 3/4) channery fine sandy loam, light yellowish brown (10YR 6/4) dry; weak fine granular structure; friable; about 15 percent sandstone channers; moderately acid; abrupt smooth boundary.

Bt1—6 to 11 inches; dark yellowish brown (10YR 4/6) channery fine sandy loam; moderate medium subangular blocky structure; friable; few thin distinct dark yellowish brown (10YR 3/4) clay films on faces of peds; about 20 percent sandstone channers; slightly acid; clear wavy boundary.

Bt2—11 to 18 inches; dark yellowish brown (10YR 4/6) fine sandy loam; moderate medium subangular blocky structure; friable; few thin distinct dark yellowish brown (10YR 3/4) clay films on faces of peds; about 10 percent sandstone channers; slightly acid; clear wavy boundary.

2C—18 to 37 inches; dark yellowish brown (10YR 4/6) very channery loamy fine sand; single grain; loose; about 35 percent sandstone channers; slightly acid; gradual irregular boundary.
2Cr—37 inches; weakly cemented sandstone.

The thickness of the solum ranges from 15 to 18 inches. Depth to the paralithic contact ranges from 18 to 38 inches. The content of channers and cobbles ranges from 10 to 35 percent throughout the profile.

The Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 1 to 4. It is channery fine sandy loam.

The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is channery fine sandy loam, sandy loam, or fine sandy loam.

The 2C horizon has hue of 10YR and value and chroma of 4 to 6. It is channery sand, channery fine sand, channery loamy fine sand, or very channery loamy fine sand.

Fox Series

The Fox series consists of very deep, well drained soils on outwash plains and stream terraces. These soils formed in loamy outwash underlain by sandy and gravelly outwash. Permeability is moderate in the upper part and rapid in the lower part. Slopes range from 1 to 35 percent.

Typical pedon of Fox sandy loam, 1 to 6 percent slopes, 2,420 feet east and 1,600 feet south of the northwest corner of sec. 30, T. 6 S., R. 1 W.

Ap—0 to 8 inches; dark brown (10YR 4/3) sandy loam, grayish brown (10YR 5/2) dry; moderate medium granular structure; friable; about 10 percent rock fragments; neutral; abrupt wavy boundary.
E—8 to 11 inches; dark brown (7.5YR 4/2) sandy loam; moderate thick platy structure; friable; about 10 percent rock fragments; neutral; abrupt wavy boundary.
Bt1—11 to 17 inches; dark brown (7.5YR 4/4) sandy loam; weak medium subangular blocky structure; friable; common thick clay bridges; about 15 percent gravel; neutral; gradual wavy boundary.
Bt2—17 to 24 inches; dark brown (7.5YR 4/4) gravelly sandy loam; moderate medium subangular blocky structure; friable; few thin dark reddish brown (5YR 3/2) clay films on faces of peds and common clay bridging; about 15 percent gravel; neutral; abrupt irregular boundary.
Bt3—24 to 34 inches; dark brown (7.5YR 3/4) gravelly sandy clay loam; strong fine subangular blocky structure; firm; common distinct dark reddish brown (5YR 3/2) clay films on faces of peds; about 18 percent gravel; neutral; abrupt irregular boundary.
2Bk—34 to 38 inches; dark yellowish brown (10YR 4/4) sand and gravel; single grain; loose; lime pendants on the underside of rock fragments; about 10 percent gravel; strongly effervescent; slightly alkaline; clear irregular boundary.
2C—38 to 60 inches; brown (10YR 5/3) sand and gravel; single grain; loose; about 20 percent gravel; strongly effervescent; slightly alkaline.

The thickness of the solum and the depth to free carbonates range from 27 to 40 inches. The content of gravel ranges from 5 to 25 percent in the solum and from 10 to 50 percent in the 2C horizon.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. In some eroded pedons it has chroma of 4. Some pedons have an A horizon. This horizon has value of 2 or 3. It is sandy loam or gravelly sandy loam.

The E horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. It is sandy loam or gravelly sandy loam.

The Bt horizon has hue of 10YR or 7.5YR and value and chroma of 3 or 4. It is sandy loam, sandy clay loam, clay loam, or the gravelly analogs of these textures.

The 2C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is sand, coarse sand, or stratified sand and gravel.

Gilford Series

The Gilford series consists of very deep, poorly drained soils in depressions on outwash plains. These soils formed in loamy outwash underlain by sandy and gravelly outwash. Permeability is moderately rapid in the upper part and very rapid in the lower part. Slopes range from 0 to 2 percent.

Typical pedon of Gilford sandy loam, 900 feet west and 1,700 feet south of the northeast corner of sec. 14, T. 6 S., R. 2 W.

Ap—0 to 12 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; weak medium granular structure; friable; about 5 percent gravel; neutral; clear wavy boundary.
A—12 to 16 inches; very dark gray (10YR 3/1) sandy loam, grayish brown (10YR 5/2) dry; few fine prominent brownish yellow (10YR 6/8) and common medium prominent olive gray (5Y 4/2) mottles; moderate medium subangular blocky structure; friable; about 5 percent gravel; neutral; clear wavy boundary.
Bg1—16 to 24 inches; grayish brown (10YR 5/2) sandy loam; few medium prominent olive gray (5Y 4/2) and few coarse prominent light olive brown (2.5Y

5/6) mottles; weak medium subangular blocky structure; friable; about 5 percent gravel; neutral; clear wavy boundary.

Bg2—24 to 36 inches; grayish brown (10YR 5/2) sandy loam; common fine prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; ½-inch strata of olive gray (5Y 4/2) sandy clay loam; about 5 percent gravel; slightly alkaline; abrupt irregular boundary.

2Cg1—36 to 42 inches; grayish brown (10YR 5/2) loamy sand; common medium prominent light olive brown (2.5Y 5/4) mottles; single grain; loose; about 5 percent gravel; slightly effervescent; moderately alkaline; abrupt wavy boundary.

2Cg2—42 to 60 inches; gray (10YR 5/1), stratified sand and gravel; single grain; loose; about 40 percent gravel; strongly effervescent; slightly alkaline.

The thickness of the solum and the depth to free carbonates range from 28 to 43 inches. The content of gravel ranges from 2 to 8 percent in the solum and from 5 to 50 percent in the 2C horizon.

The Ap and A horizons have hue of 10YR, value of 2 or 3, and chroma of 1 or 2. They are sandy loam or mucky sandy loam.

The Bg horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is sandy loam.

The 2C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is loamy sand, coarse sand, sand, or stratified sand and gravel.

Glendora Series

The Glendora series consists of very deep, very poorly drained soils on first-bottom flood plains. These soils formed in sandy alluvium. Permeability is rapid. Slopes range from 0 to 2 percent.

The Glendora soils in this survey area have a thicker surface layer than is defined as the range for the series. Also, they have an irregular decrease in organic matter content. These differences, however, do not affect the use or management of the soils.

Typical pedon of Glendora mucky loamy sand, frequently flooded, 1,350 feet west and 2,710 feet south of the northeast corner of sec. 8, T. 7 S., R. 4 W.

A—0 to 16 inches; black (10YR 2/1) mucky loamy sand, dark gray (10YR 4/1) dry; weak fine granular structure; friable; moderately acid; abrupt wavy boundary.

C1—16 to 20 inches; pale brown (10YR 6/3) sand; common coarse faint light brownish gray (10YR 6/2) mottles; single grain; loose; black (10YR 2/1) organic band 1 inch thick; slightly alkaline; abrupt wavy boundary.

C2—20 to 36 inches; yellowish brown (10YR 5/4) sand; few fine distinct light brownish gray (10YR 6/2) and few fine faint grayish brown (10YR 5/2) mottles; single grain; loose; black (10YR 2/1) organic bands ⅛ to ¼ inch thick; neutral; abrupt wavy boundary.

Cg1—36 to 52 inches; dark grayish brown (10YR 4/2) sand; neutral; abrupt wavy boundary.

Cg2—52 to 60 inches; grayish brown (10YR 5/2) sand; single grain; loose; neutral.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is mucky loamy sand.

The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. It is sand or fine sand. Organic bands have colors similar to those of the A horizon.

Glynwood Series

The Glynwood series consists of very deep, moderately well drained soils on end moraines and ground moraines. These soils formed in loamy glacial till. Permeability is slow. Slopes range from 2 to 6 percent.

Typical pedon of Glynwood clay loam, in an area of Glynwood-Blount complex, 1 to 6 percent slopes; in an area where the slope is 5 percent; 175 feet east and 820 feet south of the northwest corner of sec. 33, T. 8 S., R. 1 W.

Ap—0 to 7 inches; brown (10YR 5/3) clay loam, pale brown (10YR 6/3) dry; moderate medium angular blocky structure; firm; about 3 percent gravel; slightly alkaline; abrupt smooth boundary.

Bt1—7 to 14 inches; dark brown (10YR 4/3) clay loam; moderate medium angular blocky structure; firm; few faint brown (10YR 5/3) clay films on faces of peds; about 3 percent gravel; discontinuous grayish brown (10YR 5/2) E material at top of horizon; neutral; clear wavy boundary.

Bt2—14 to 23 inches; dark brown (10YR 4/3) clay; few fine prominent light brownish gray (10YR 6/2) and common medium faint grayish brown (10YR 5/2) mottles; moderate medium angular blocky structure; firm; common distinct brown (10YR 5/3) clay films on faces of peds; about 3 percent gravel; slightly alkaline; clear wavy boundary.

BC—23 to 26 inches; dark brown (10YR 4/3) clay loam; few fine distinct light brownish gray (10YR 6/2) and common medium faint grayish brown (10YR 5/2) mottles; weak thick platy structure parting to moderate fine angular blocky; discontinuous distinct brown (10YR 5/3) clay films on faces of peds; few fine prominent white (10YR 8/2) lime threads; about 3 percent gravel; strongly effervescent; slightly

alkaline; clear irregular boundary.
C—26 to 60 inches; grayish brown (10YR 5/2) clay loam; few medium faint light brownish gray (10YR 6/2) and common medium distinct yellowish brown (10YR 5/8) mottles; massive; firm; few fine prominent white (10YR 8/2) lime threads and coatings on rock fragments; about 3 percent gravel; strongly effervescent; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 25 to 37 inches. The content of gravel and cobbles ranges from 1 to 5 percent throughout the profile.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. Some pedons have an A horizon. This horizon has hue of 10YR, value of 3, and chroma of 2. It is clay loam.

The Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is clay loam, clay, silty clay loam, or silty clay. The BC horizon has colors similar to those of the Bt horizon. It is clay loam or silty clay loam.

The C horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is clay loam.

Hillsdale Series

The Hillsdale series consists of very deep, well drained soils on ground moraines and end moraines. These soils formed in loamy glacial till. Permeability is moderate. Slopes range from 2 to 35 percent.

Typical pedon of Hillsdale sandy loam, in an area of Hillsdale-Riddles complex, 2 to 6 percent slopes; in an area where the slope is 2 percent; 80 feet west and 1,100 feet south of the northeast corner of sec. 36, T. 6 S., R. 3 W.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) sandy loam, pale brown (10YR 6/3) dry; weak fine granular structure; friable; about 5 percent gravel; slightly acid; clear smooth boundary.
Bt1—9 to 15 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate medium subangular blocky structure; friable; common distinct brown (7.5YR 4/3) clay films on faces of peds; about 5 percent gravel; slightly acid; clear wavy boundary.
Bt2—15 to 28 inches; strong brown (7.5YR 4/6) sandy clay loam; weak coarse subangular blocky structure; friable; common faint brown (7.5YR 4/4) clay films on faces of peds; about 5 percent gravel; moderately acid; clear wavy boundary.
Bt3—28 to 43 inches; strong brown (7.5YR 4/6) sandy loam; moderate medium subangular blocky structure; friable; common faint brown (7.5YR 4/4) clay films on faces of peds; about 5 percent gravel; slightly acid; clear wavy boundary.
C—43 to 60 inches; yellowish brown (10YR 5/4) fine sandy loam; massive; friable; about 5 percent gravel; strongly effervescent; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 42 to 60 inches. The content of gravel and cobbles ranges from 3 to 10 percent throughout the solum.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. Some pedons have an A horizon. This horizon has hue of 10YR and value and chroma of 2. It is sandy loam.

Some pedons have an E horizon. This horizon has hue of 10YR, value of 5, and chroma of 3 or 4. It is sandy loam or fine sandy loam.

The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is sandy loam or sandy clay loam.

The C horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. It is sandy loam or fine sandy loam.

Houghton Series

The Houghton series consists of very deep, very poorly drained soils in depressions on ground moraines, end moraines, and lake plains. These soils formed in deposits of organic material that are more than 51 inches thick. Permeability is moderately slow to moderately rapid. Slopes range from 0 to 2 percent.

Typical pedon of Houghton muck, 60 feet east and 1,820 feet north of the southwest corner of sec. 30, T. 6 S., R. 1 W.

Oa1—0 to 9 inches; muck, black (7.5YR 2/0) and very dark brown (7.5YR 2/2) broken face and rubbed; weak medium subangular blocky structure; friable; neutral; clear smooth boundary.
Oa2—9 to 22 inches; muck, black (7.5YR 2/0) broken face and rubbed; weak medium subangular blocky structure; friable; neutral; clear smooth boundary.
Oa3—22 to 31 inches; muck, black (7.5YR 2/0) broken face and rubbed; about 5 percent very dark brown (10YR 3/2) woody fiber; weak thin platy structure; friable; neutral; clear smooth boundary.
Oa4—31 to 44 inches; muck, black (7.5YR 2/0) broken face and rubbed; about 15 percent very dark grayish brown (10YR 3/2) woody fiber; moderate medium platy structure; friable; neutral; abrupt smooth boundary.
Oa5—44 to 60 inches; muck, very dark brown (10YR 2/2) broken face and rubbed; moderate thick platy structure; friable; neutral.

The organic material is more than 51 inches thick. It is mainly herbaceous, but in some pedons as much as

15 percent is woody fragments.

The organic layers have hue of 10YR, 7.5YR, or 5YR or are neutral in hue. They have value of 2 or 3 and chroma of 0 to 2.

Leoni Series

The Leoni series consists of very deep, well drained soils on outwash plains and kames. These soils formed in gravelly loamy outwash material and in the underlying gravelly sandy outwash material. Permeability is moderate in the upper part and rapid in the lower part. Slopes range from 1 to 18 percent.

Typical pedon of Leoni very gravelly sandy loam, 12 to 18 percent slopes, eroded, 4,130 feet east and 1,410 feet north of the southwest corner of sec. 9, T. 7 S., R. 2 W.

Ap—0 to 8 inches; dark brown (10YR 3/3) very gravelly sandy loam, pale brown (10YR 6/3) dry; moderate medium granular structure; friable; about 15 percent gravel and 5 percent cobbles; slightly acid; abrupt smooth boundary.

Bt1—8 to 18 inches; brown (7.5YR 4/4) very gravelly clay loam; moderate fine subangular blocky structure; firm; common distinct dark brown (7.5YR 3/2) clay films on faces of peds and on rock fragments; about 30 percent gravel and 5 percent cobbles; neutral; clear irregular boundary.

2Bt2—18 to 30 inches; brown (7.5YR 4/4) extremely gravelly sandy loam; weak medium subangular blocky structure; friable; few distinct dark brown (7.5YR 3/2) clay films on faces of peds and rock fragments; about 55 percent gravel and 10 percent cobbles; neutral; gradual irregular boundary.

2Bk—30 to 42 inches; dark brown (7.5YR 4/4) extremely gravelly loamy sand (about 65 percent) and yellowish brown (10YR 5/4) gravelly coarse sand; weak fine subangular blocky structure; very friable; common clay bridging; lime pendants on the underside of rock fragments; about 50 percent gravel and 15 percent cobbles; strongly effervescent; slightly alkaline; gradual wavy boundary.

2C—42 to 60 inches; yellowish brown (10YR 5/4) gravelly coarse sand; single grain; loose; about 15 percent gravel and 4 percent cobbles; strongly effervescent; slightly alkaline.

The thickness of the solum and the depth to free carbonates range from 32 to 42 inches. The content of rock fragments ranges from 15 to 35 percent in the A horizon, from 35 to 65 percent in the B horizons, and from 15 to 60 percent in the 2C horizon.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. In some eroded pedons it has chroma of 4. Some pedons have an A horizon. This horizon has hue of 10YR, value of 2, and chroma of 3. It is very gravelly sandy loam.

The Bt horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 4. It is the very gravelly or extremely gravelly analogs of sandy loam, sandy clay loam, or clay loam.

The Bk horizon has hue of 10YR, value of 4 or 5, and chroma of 4 to 6. It very gravelly or extremely gravelly loamy sand, coarse sand, or gravelly coarse sand.

The 2C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is gravelly, very gravelly, or extremely gravelly coarse sand or sand.

Locke Series

The Locke series consists of very deep, somewhat poorly drained soils on ground moraines. These soils formed in loamy glacial till. Permeability is moderate. Slopes range from 0 to 3 percent.

Typical pedon of Locke fine sandy loam, 0 to 3 percent slopes, 940 feet east and 80 feet north of the southwest corner of sec. 19, T. 7 S., R. 4 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; moderate medium subangular blocky structure; friable; about 5 percent gravel; slightly acid; abrupt smooth boundary.

Bt1—9 to 14 inches; yellowish brown (10YR 5/4) loam; many medium distinct dark yellowish brown (10YR 4/6) and many medium faint brown (10YR 5/3) mottles; moderate medium subangular blocky structure; firm; common faint dark grayish brown (10YR 4/2) and very dark brown (10YR 2/2) clay films on faces of peds; about 6 percent gravel; neutral; clear smooth boundary.

2Bt2—14 to 24 inches; brown (10YR 5/3) loam; few fine distinct dark yellowish brown (10YR 4/4 and 4/6) and few fine faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; common faint light brownish gray (10YR 6/2) and dark grayish brown (10YR 4/2) and common distinct gray (10YR 6/1) clay films on faces of peds; about 2 percent gravel; moderately alkaline; clear smooth boundary.

2Btk—24 to 37 inches; brown (10YR 5/3) loam; many medium distinct dark yellowish brown (10YR 4/6) and many medium faint dark yellowish brown (10YR 4/4) and grayish brown (10YR 5/2) mottles; weak thick platy structure parting to moderate medium subangular blocky; firm; common faint light brownish gray (10YR 6/2) clay films on faces of

peds; common distinct light gray (10YR 6/1) lime pendants on rock fragments; about 4 percent gravel; strongly effervescent on ped coatings; moderately alkaline; gradual smooth boundary.

2C—37 to 60 inches; brown (10YR 5/3) fine sandy loam; many medium faint light yellowish brown (10YR 6/4) and light brownish gray (10YR 6/2) mottles; massive; friable; common medium distinct light gray (10YR 6/1), soft masses of carbonates; about 4 percent gravel; violently effervescent; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 24 to 37 inches. The content of gravel and cobbles ranges from 2 to 6 percent throughout the solum.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is fine sandy loam.

The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is sandy loam or loam. The Btk horizon has colors and textures similar to those of the Bt horizon.

The 2C horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. It is sandy loam or fine sandy loam.

Matherton Series

The Matherton series consists of very deep, somewhat poorly drained soils on outwash plains. These soils formed in loamy outwash and sandy and gravelly outwash. Permeability is moderate in the upper part and rapid in the lower part. Slopes range from 0 to 3 percent.

Typical pedon of Matherton loam, 0 to 3 percent slopes, 80 feet west and 340 feet north of the southeast corner of sec. 14, T. 6 S., R. 1 W.

Ap—0 to 9 inches; dark brown (10YR 3/3) loam, dark brown (10YR 4/3) dry; moderate medium granular structure; friable; about 2 percent gravel; neutral; abrupt smooth boundary.

Bt1—9 to 15 inches; dark yellowish brown (10YR 4/4) sandy clay loam; common medium distinct light brownish gray (10YR 6/2) and common medium prominent yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; friable; few prominent strong brown (7.5YR 4/6) clay films on faces of peds; about 2 percent gravel; neutral; gradual wavy boundary.

Bt2—15 to 23 inches; dark yellowish brown (10YR 4/4) loam; many medium distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; few strong brown (7.5YR 4/6) clay films on faces of peds; friable; about 2 percent gravel; neutral; gradual wavy boundary.

2Btg—23 to 25 inches; dark grayish brown (10YR 4/2) gravelly loam; few fine prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; few dark yellowish brown (10YR 4/6) clay films on faces of peds; about 5 percent gravel; neutral; abrupt wavy boundary.

2Cg1—25 to 38 inches; grayish brown (10YR 5/2) gravelly coarse sand; single grain; loose; about 25 percent gravel; strongly effervescent; slightly alkaline; abrupt wavy boundary.

3Cg2—38 to 60 inches; dark gray (10YR 4/1) fine sand; few fine distinct dark brown (10YR 4/3) mottles; single grain; loose; about 1 percent gravel; strongly effervescent; slightly alkaline.

The thickness of the solum and the depth to free carbonates range from 25 to 32 inches. The content of gravel and cobbles ranges from 0 to 25 percent in the solum and from 1 to 45 percent in the 2C horizon.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3. It is loam.

The B horizon has hue of 10YR or 7.5YR, value of 4, and chroma of 2 to 4. It is loam, sandy clay loam, clay loam, or the gravelly analogs of these textures. Some pedons have subhorizons of sandy loam.

The 2C horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2. It is coarse sand, sand, fine sand, or the gravelly analogs of these textures or is stratified sand and gravel.

Miami Series

The Miami series consists of very deep, well drained soils on ground moraines and end moraines. These soils formed in loamy glacial till. Permeability is moderately slow. Slopes range from 6 to 35 percent.

Typical pedon of Miami loam, 6 to 12 percent slopes, eroded, 1,150 feet south and 2,600 feet west of the northeast corner of sec. 30, T. 7 S., R. 2 W.

Ap—0 to 6 inches; dark brown (10YR 3/3) loam, pale brown (10YR 6/3) dry; weak fine angular blocky structure; firm; about 3 percent gravel; slightly acid; abrupt wavy boundary.

Bt1—6 to 11 inches; dark yellowish brown (10YR 4/4) clay loam; strong medium angular blocky structure; firm; common faint dark brown (10YR 4/3) clay films on faces of peds; few medium faint dark brown (10YR 3/3) organic stains on faces of peds; about 3 percent gravel; slightly acid; clear wavy boundary.

Bt2—11 to 24 inches; dark yellowish brown (10YR 4/4) clay loam; strong medium angular blocky structure; firm; many faint brown (10YR 4/3) clay films on

faces of peds; about 3 percent gravel; slightly acid; clear smooth boundary.

Btk—24 to 38 inches; yellowish brown (10YR 5/4) loam; few fine faint brown (10YR 5/3) mottles; moderate medium angular blocky structure; firm; common faint dark yellowish brown (10YR 4/4) clay films on faces of peds; few fine prominent white (10YR 8/2) lime pendants on the underside of rock fragments; about 5 percent gravel; slightly effervescent; slightly alkaline; gradual wavy boundary.

C—38 to 60 inches; yellowish brown (10YR 5/4) loam; few fine faint brown (10YR 5/3) mottles; massive; firm; about 7 percent gravel; strongly effervescent; moderately alkaline.

The thickness of the solum ranges from 24 to 37 inches. The depth to free carbonates ranges from 20 to 35 inches. The content of gravel and cobbles ranges from 3 to 7 percent throughout the solum.

The Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 2 to 4. Some pedons have an A horizon. This horizon has value of 2. It is loam or clay loam.

The Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is clay loam.

The Bk horizon has colors similar to those of the Bt horizon. It is loam or clay loam.

The C horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. It is loam.

Morley Series

The Morley series consists of very deep, well drained soils on ground moraines and end moraines. These soils formed in loamy glacial till. Permeability is slow. Slopes range from 6 to 35 percent.

Typical pedon of Morley loam, 6 to 12 percent slopes, eroded, 760 feet west and 580 feet south of the northeast corner of sec. 26, T. 8 S., R. 4 W.

Ap—0 to 6 inches; dark brown (10YR 3/3) loam, light brownish gray (10YR 6/2) dry; moderate fine subangular blocky structure; firm; about 5 percent gravel; neutral; abrupt smooth boundary.

Bt1—6 to 15 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; many faint brown (10YR 4/3) and many distinct very dark grayish brown (10YR 3/2) clay films on faces of peds; about 3 percent gravel; slightly acid; gradual wavy boundary.

Bt2—15 to 28 inches; dark yellowish brown (10YR 4/4) clay loam; few fine prominent strong brown (7.5YR 5/6) mottles; moderate medium angular blocky structure; firm; many faint dark brown (10YR 3/3) clay films on faces of peds; about 3 percent gravel; neutral; clear wavy boundary.

Bt3—28 to 31 inches; dark yellowish brown (10YR 4/4) clay loam; few fine prominent strong brown (7.5YR 5/6) mottles; moderate medium angular blocky structure; very firm; common distinct very dark brown (10YR 3/2) clay films on faces of peds; about 4 percent gravel; slightly effervescent; moderately alkaline; clear wavy boundary.

C—31 to 60 inches; brown (10YR 5/3) clay loam; few fine prominent strong brown (7.5YR 5/6) mottles; massive; very firm; about 5 percent gravel; violently effervescent; slightly alkaline.

The thickness of the solum and the depth to free carbonates range from 24 to 38 inches. The content of gravel and cobbles ranges from 1 to 5 percent throughout the profile.

The Ap horizon has hue of 10YR, value of 2 to 4, and chroma of 2 or 3. It is loam or clay loam.

The Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. It is clay loam, silty clay loam, or silty clay.

The C horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. It is clay loam or silty clay loam.

Napoleon Series

The Napoleon series consists of very deep, very poorly drained soils in closed depressions on ground moraines, end moraines, and lake plains. These soils formed in deposits of organic material that are more than 51 inches thick. Permeability is moderate or moderately rapid. Slopes range from 0 to 2 percent.

Typical pedon of Napoleon muck, ponded, 1,260 feet west and 20 feet south of the northeast corner of sec. 1, T. 5 S., R. 1 W.

Oa1—0 to 6 inches; muck, black (7.5YR 2/0) broken face and rubbed; about 5 percent fiber, less than 2 percent rubbed; weak medium subangular blocky structure; friable; fibers are herbaceous; extremely acid; clear smooth boundary.

Oa2—6 to 14 inches; muck, black (10YR 2/1) broken face and rubbed; about 10 percent fiber, less than 2 percent rubbed; weak medium subangular blocky structure; friable; fibers are herbaceous; extremely acid; clear smooth boundary.

Oe1—14 to 37 inches; mucky peat, very dark brown (10YR 2/2) broken face and rubbed; about 60 percent fiber, about 10 percent rubbed; weak thin platy structure; friable; fibers are herbaceous; extremely acid; clear smooth boundary.

Oe2—37 to 48 inches; peat, very dark brown (10YR 2/2) broken face and rubbed; about 80 percent fiber, about 25 percent rubbed; moderate medium platy structure; friable; fibers are herbaceous;

extremely acid; abrupt smooth boundary.
Oe3—48 to 60 inches; mucky peat, black (10YR 2/1) broken face and rubbed; about 60 percent fiber, about 20 percent rubbed; moderate thick platy structure; friable; fibers are herbaceous; extremely acid.

The organic material is more than 51 inches thick. It is mainly herbaceous. In some pedons, however, as much as 15 percent of the organic material is woody fragments.

The organic layers have hue of 10YR, 7.5YR, or 5YR, value of 2 or 3, and chroma of 0 to 2.

Palms Series

The Palms series consists of very deep, very poorly drained soils in depressions in ground moraines, end moraines, and lake plains. These soils formed in organic material and in the underlying loamy deposits. Permeability is moderately slow to moderately rapid in the organic material and moderate or moderately slow in the loamy material. Slopes range from 0 to 2 percent.

Typical pedon of Palms muck, 1,850 feet east and 70 feet south of the northwest corner of sec. 28, T. 8 S., R. 1 W.

Oa1—0 to 13 inches; muck, black (N 2/0) broken face and rubbed; about 3 percent fiber, less than 3 percent rubbed; weak fine granular structure; friable; fibers are herbaceous; slightly alkaline; abrupt wavy boundary.
Oa2—13 to 16 inches; muck, very dark grayish brown (10YR 3/2) broken face and black (N 2/0) rubbed; many fine prominent strong brown (7.5YR 5/8) mottles; about 5 percent fiber rubbed; moderate thick platy structure; friable; fibers are herbaceous; neutral; abrupt wavy boundary.
2C—16 to 23 inches; dark yellowish brown (10YR 4/4) silt loam; few medium faint brown (10YR 5/3) mottles; moderate thick platy structure; friable; about 5 percent snail shells; slightly alkaline; abrupt wavy boundary.
2Cg1—23 to 28 inches; grayish brown (10YR 5/2) silt loam; common coarse prominent yellowish brown (10YR 5/6) mottles; moderate thick platy structure; friable; slightly alkaline; abrupt smooth boundary.
2Cg2—28 to 60 inches; gray (10YR 5/1), stratified sandy loam and silty clay loam; many coarse prominent dark yellowish brown (10YR 4/6) mottles; massive; firm; slightly alkaline.

The organic material ranges from 16 to 23 inches in thickness. It is mainly herbaceous. In some pedons, however, as much as 15 percent of the organic material is woody fragments.

The surface tier has hue of 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2.

The subsurface tier has hue of 10YR or 7.5YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2.

The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 4. It is sandy loam, loam, silt loam, or silty clay loam.

Pewamo Series

The Pewamo series consists of very deep, poorly drained soils in depressions on ground moraines and end moraines. These soils formed in silty and loamy glacial till. Permeability is moderately slow. Slopes range from 0 to 2 percent.

Typical pedon of Pewamo silt loam, 2,010 feet west and 1,330 feet south of the northeast corner of sec. 10, T. 9 S., R. 2 W.

Ap—0 to 11 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; friable; about 2 percent gravel; neutral; clear smooth boundary.
Btg1—11 to 17 inches; grayish brown (10YR 5/2) clay loam; few fine prominent dark yellowish brown (10YR 4/6) and few fine faint brown (10YR 5/3) mottles; strong medium angular blocky structure; firm; many continuous dark grayish brown (10YR 4/2) clay films on faces of peds; about 3 percent gravel; neutral; gradual smooth boundary.
Btg2—17 to 48 inches; dark grayish brown (10YR 4/2) clay loam; many medium prominent dark yellowish brown (10YR 4/6) mottles; strong medium angular blocky structure; firm; many discontinuous dark grayish brown (10YR 4/2) clay films on faces of peds; about 3 percent gravel; neutral; gradual smooth boundary.
Cg—48 to 60 inches; gray (10YR 5/1) clay loam; many coarse prominent dark yellowish brown (10YR 4/6) mottles; massive; firm; about 3 percent gravel; slightly alkaline.

The thickness of the solum ranges from 30 to 60 inches. The content of gravel and cobbles ranges from 1 to 3 percent throughout the solum.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is silt loam.

The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is clay loam or silty clay.

The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is clay loam or silty clay loam.

Riddles Series

The Riddles series consists of very deep, well drained soils on ground moraines and end moraines. These soils formed in loamy glacial till. Permeability is moderate. Slopes range from 2 to 35 percent.

Typical pedon of Riddles sandy loam, 2 to 6 percent slopes, 1,500 feet east and 2,700 feet south of the northwest corner of sec. 28, T. 7 S., R. 4 W.

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) sandy loam, light brownish gray (10YR 6/2) dry; moderate medium subangular blocky structure; friable; about 4 percent gravel; slightly acid; abrupt smooth boundary.

E—10 to 17 inches; yellowish brown (10YR 5/4) sandy loam; weak thick platy structure parting to moderate medium subangular blocky; friable; about 5 percent gravel; moderately acid; clear wavy boundary.

Bt1—17 to 22 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate medium subangular blocky structure; firm; common distinct dark grayish brown (10YR 4/2) clay films on faces of peds; about 5 percent gravel; slightly acid; clear wavy boundary.

Bt2—22 to 31 inches; dark yellowish brown (10YR 4/6) sandy clay loam; moderate medium subangular blocky structure; firm; common distinct dark grayish brown (10YR 4/2) clay films on faces of peds; about 5 percent gravel; neutral; clear wavy boundary.

Bt3—31 to 40 inches; dark yellowish brown (10YR 4/4) sandy clay loam; weak medium subangular blocky structure; firm; common faint dark yellowish brown (10YR 3/4) clay films on faces of peds; about 7 percent gravel; neutral; clear wavy boundary.

C—40 to 60 inches; brown (10YR 5/3) sandy loam; common medium distinct yellowish brown (10YR 5/6) mottles; massive; friable; few light brownish gray (10YR 6/2) lime threads; about 5 percent gravel; slightly effervescent; slightly alkaline.

The thickness of the solum and the depth to free carbonates range from 40 to 48 inches. The content of gravel and cobbles ranges from 4 to 7 percent throughout the profile.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 to 4. It is sandy loam. The E horizon has hue of 10YR, value of 5, and chroma of 2 to 4. It is loam or sandy loam.

The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is loam, sandy loam, or sandy clay loam.

The C horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. It is sandy loam or loam.

Sebewa Series

The Sebewa series consists of very deep, poorly drained soils in depressions on outwash plains. These soils formed in loamy outwash and in the underlying sandy and gravelly outwash. Permeability is moderate in the upper part and rapid in the lower part. Slopes range from 0 to 2 percent.

Typical pedon of Sebewa loam, 1,480 feet west and 520 feet south of the northeast corner of sec. 35, T. 7 S., R. 1 W.

Ap—0 to 11 inches; very dark gray (10YR 3/1) loam, grayish brown (10YR 5/2) dry; moderate medium angular blocky structure; firm; about 3 percent gravel; neutral; abrupt smooth boundary.

Btg1—11 to 16 inches; grayish brown (10YR 5/2) clay loam; many medium faint brown (10YR 5/3) and common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few faint gray (10YR 5/1) clay films on faces of peds; about 5 percent gravel; neutral; clear wavy boundary.

Btg2—16 to 23 inches; grayish brown (10YR 5/2) clay loam; common medium prominent yellowish brown (10YR 5/6 and 5/8) mottles; moderate medium subangular blocky structure; firm; few faint dark gray (10YR 4/1) clay films on faces of peds; about 5 percent gravel; neutral; abrupt irregular boundary.

2Cg1—23 to 34 inches; light brownish gray (10YR 6/2), stratified sand and loamy sand; common coarse faint grayish brown (10YR 5/2) and common medium prominent yellowish brown (10YR 5/6) mottles; weak thick platy structure; very friable; about 10 percent gravel; slightly effervescent; moderately alkaline; abrupt irregular boundary.

2Cg2—34 to 60 inches; grayish brown (10YR 5/2) gravelly coarse sand; many fine faint gray (10YR 5/1) and many fine distinct yellowish brown (10YR 5/6) mottles; single grain; loose; about 30 percent gravel; strongly effervescent; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 20 to 36 inches. The content of gravel and cobbles ranges from 5 to 10 percent in the solum and from 15 to 45 percent in the 2C horizon.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is loam.

The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is loam, clay loam, or gravelly clay loam.

The 2C horizon has hue of 10YR, value of 5 or 6, and chroma of 1 or 2. It is gravelly coarse sand, gravelly sand, or stratified sand and gravel.

Seward Series

The Seward series consists of very deep, moderately well drained soils on dunes. These soils formed in sandy eolian material over loamy glacial till. Permeability is rapid in the upper sandy part and slow or very slow in the loamy part. Slopes range from 0 to 4 percent.

Typical pedon of Seward loamy sand, 0 to 4 percent slopes, 50 feet east and 2,440 feet south of the northwest corner of sec. 9, T. 9 S., R. 2 W.

Ap—0 to 8 inches; dark brown (10YR 3/3) loamy sand, light brownish gray (10YR 6/2) dry; moderate fine granular structure; very friable; about 2 percent gravel; slightly acid; abrupt smooth boundary.

E1—8 to 17 inches; yellowish brown (10YR 5/4) loamy sand; single grain; loose; about 1 percent gravel; slightly acid; clear wavy boundary.

E2—17 to 30 inches; brown (10YR 5/3) loamy sand; common coarse faint grayish brown (10YR 5/2) and few medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; very friable; about 1 percent gravel; slightly acid; clear wavy boundary.

E3—30 to 35 inches; yellowish brown (10YR 5/4) loamy sand; weak medium subangular blocky structure; very friable; few thin discontinuous lamellae of dark yellowish brown (10YR 4/4) sandy loam at base of horizon; about 2 percent gravel; moderately acid; clear wavy boundary.

Bt—35 to 40 inches; dark yellowish brown (10YR 4/4) sandy loam; common medium distinct yellowish brown (10YR 5/6) and common fine distinct dark grayish brown (10YR 4/2) mottles; weak medium subangular blocky structure; friable; common faint dark brown (10YR 4/3) clay films on faces of peds; about 2 percent gravel; neutral; abrupt wavy boundary.

2C—40 to 60 inches; brown (10YR 5/3) silty clay loam; many coarse distinct dark gray (10YR 4/1) and common medium faint dark yellowish brown (10YR 4/4) mottles; massive; about 8 percent gravel; violently effervescent; slightly alkaline.

The thickness of the solum ranges from 25 to 40 inches. The thickness of the arenic epipedon ranges from 20 to 35 inches. The depth to glacial till ranges from 32 to 40 inches

The A horizon has hue of 10YR, value of 3 to 5, and chroma of 2 to 4. It is loamy sand. The E horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 6. It is loamy sand.

The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is sandy loam.

The 2C horizon has colors similar to those of the B horizon. It is clay loam or silty clay loam.

Shoals Series

The Shoals series consists of very deep, somewhat poorly drained soils on second-bottom flood plains. These soils formed in loamy alluvium. Permeability is moderate. Slopes range from 0 to 2 percent.

Typical pedon of Shoals loam, occasionally flooded, 950 feet west and 2,440 feet south of the northeast corner of sec. 8, T. 9 S., R. 2 W.

A—0 to 8 inches; dark grayish brown (10YR 4/2) loam; moderate medium granular structure; friable; slightly alkaline; clear wavy boundary.

C1—8 to 18 inches; brown (10YR 5/3) silt loam; common medium faint grayish brown (10YR 5/2) mottles; moderate medium granular structure; friable; slightly alkaline; clear wavy boundary.

C2—18 to 30 inches; grayish brown (10YR 5/2) silt loam; common fine prominent yellowish brown (10YR 5/6) and many medium distinct dark yellowish brown (10YR 4/4) mottles; weak coarse granular structure; friable; slightly alkaline; clear wavy boundary.

C3—30 to 49 inches; grayish brown (10YR 5/2), stratified silt loam and fine sandy loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; massive; friable; slightly alkaline; clear wavy boundary.

C4—49 to 60 inches; gray (10YR 6/1) fine sandy loam; very dark brown (10YR 2/2) organic bands ½ inch thick; many medium faint light brownish gray (10YR 6/2) and common medium faint grayish brown (10YR 5/2) mottles; massive; friable; slightly alkaline.

The A horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is silt loam.

The C horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 to 4. It is silt loam, fine sandy loam, or loam.

Sloan Series

The Sloan series consists of very deep, very poorly drained soils on flood plains. These soils formed in loamy alluvium. Permeability is moderate or moderately slow. Slopes range from 0 to 2 percent.

Typical pedon of Sloan silt loam, frequently flooded, 1,290 feet west and 790 feet north of the southeast corner of sec. 25, T. 6 S., R. 1 W.

A—0 to 16 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry;

moderate medium granular structure; friable; slightly alkaline; gradual smooth boundary.

Bg1—16 to 25 inches; dark gray (10YR 4/1) loam; common fine prominent dark yellowish brown (10YR 4/6) mottles; weak medium subangular blocky structure; friable; slightly alkaline; gradual wavy boundary.

Bg2—25 to 31 inches; dark grayish brown (10YR 4/2) loam; black (10YR 2/1) organic bands ¼ to 1 inch thick; common medium prominent dark yellowish brown (10YR 4/6) mottles; weak medium subangular blocky structure; firm; neutral; gradual wavy boundary.

Cg1—31 to 42 inches; grayish brown (10YR 5/2), stratified silt loam and fine sandy loam; black (10YR 2/1) organic bands ¼ to 1 inch thick; common medium prominent dark yellowish brown (10YR 4/6) and common medium faint brown (10YR 5/3) mottles; moderate very thick platy structure; friable; neutral; gradual wavy boundary.

Cg2—42 to 60 inches; dark gray (10YR 4/1), stratified silt loam and fine sandy loam; black (10YR 2/1) organic bands ¼ to 1 inch thick and common medium prominent dark brown (7.5YR 3/4) organic stains; common coarse prominent dark yellowish brown (10YR 4/6) mottles; moderate very thick platy structure; friable; slightly alkaline.

The thickness of the solum ranges from 21 to 35 inches. The content of gravel and cobbles ranges from 0 to 5 percent throughout the solum.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is silt loam.

The B horizon has hue of 10YR or 2.5Y or is neutral in hue. It has value of 4 or 5 and chroma of 0 to 2. It is loam or silt loam.

The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is stratified silt loam, fine sandy loam, or loam.

Spinks Series

The Spinks series consists of very deep, well drained soils on outwash plains, ground moraines, and end moraines. These soils formed in sandy outwash or glacial till. Permeability is moderately rapid. Slopes range from 0 to 18 percent.

Typical pedon of Spinks loamy sand, 0 to 6 percent slopes, 1,540 feet south and 2,400 feet west of the northeast corner of sec. 6, T. 5 S., R. 1 W.

Ap—0 to 9 inches; dark yellowish brown (10YR 3/4) loamy sand, pale brown (10YR 6/3) dry; moderate fine granular structure; very friable; neutral; abrupt smooth boundary.

E—9 to 19 inches; yellowish brown (10YR 5/6) loamy sand; weak fine subangular blocky structure; very friable; neutral; diffuse wavy boundary.

E and Bt1—19 to 39 inches; yellowish brown (10YR 5/6) sand (E); single grain; loose; lamellae of strong brown (7.5YR 4/6) sandy loam (Bt); continuous distinct clay bridges between mineral grains; neutral; diffuse wavy boundary.

E and Bt2—39 to 60 inches; yellowish brown (10YR 5/6) sand (E); single grain; loose; discontinuous lamellae of strong brown (7.5YR 4/6) sandy loam (Bt) 2 to 5 inches thick; moderate medium subangular blocky structure in the thicker bands; friable; few distinct clay films on faces of peds; slightly acid.

The thickness of the solum is generally more than 55 inches.

The A horizon has hue of 10YR, value of 3 to 5, and chroma of 2 to 4. It is loamy sand. The E horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 6. It is loamy sand or sand.

The Bt part of the E and Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. The Bt part is sandy loam or loamy sand and occurs as bands or lamellae ⅛ inch to 5 inches thick, spaced 5 to 10 inches apart, with a cumulative thickness of more than 6 inches. The E part of the E and Bt horizon has hue of 10YR, value of 5 or 6, and chroma of 4 to 6.

Steamburg Series

The Steamburg series consists of very deep, well drained soils on ground moraines and end moraines. These soils formed in loamy glaciofluvial deposits and in the underlying loamy glacial till. Permeability is moderately rapid in the upper part and moderately slow in the lower part. Slopes range from 2 to 18 percent.

Typical pedon of Steamburg sandy loam, 6 to 12 percent slopes, 130 feet east and 2,220 feet south of the northwest corner of sec. 7, T. 7 S., R. 1 W.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) sandy loam, pale brown (10YR 6/3) dry; weak medium granular structure; friable; about 5 percent gravel; neutral; abrupt smooth boundary.

B/E1—9 to 18 inches; about 60 percent dark yellowish brown (10YR 4/4) sandy loam (Bt); common faint dark brown (10YR 4/3) clay films on faces of peds; penetrated by tongues of light yellowish brown (10YR 6/4) loamy sand (E); moderate medium subangular blocky structure; friable; about 1 percent gravel; slightly acid; clear irregular boundary.

B/E2—18 to 34 inches; about 80 percent dark yellowish brown (10YR 4/4) sandy loam (Bt); common faint

dark brown (10YR 4/3) clay films on faces of peds; penetrated by tongues of light yellowish brown (10YR 6/4) loamy sand (E); moderate medium subangular blocky structure; friable; few fine prominent black (N 2/0) manganese stains; about 5 percent gravel; neutral; clear irregular boundary.

2Bt—34 to 40 inches; yellowish brown (10YR 5/4) clay loam; few fine faint light brownish gray (10YR 6/2) and few fine distinct gray (10YR 5/1) mottles; moderate medium angular blocky structure; firm; common distinct dark brown (10YR 4/3) clay films on faces of peds; about 10 percent gravel; slightly alkaline; clear wavy boundary.

2C—40 to 60 inches; dark brown (10YR 4/3) clay loam; massive; firm; about 12 percent gravel; strongly effervescent; slightly alkaline.

The thickness of the solum and the depth to free carbonates range from 38 to 47 inches. The content of gravel and cobbles ranges from 1 to 12 percent throughout the profile.

The Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 2 to 4. It is sandy loam.

The Bt part of the Bt/E horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 or 4. The E part has hue of 10YR, value of 5 or 6, and chroma of 4.

The 2Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is loam, clay loam, or silty clay loam.

The 2C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is loam or clay loam.

Thetford Series

The Thetford series consists of very deep, somewhat poorly drained soils on outwash plains. These soils formed in sandy outwash or sandy eolian deposits. Permeability is moderately rapid. Slopes range from 0 to 4 percent.

Typical pedon of Thetford loamy sand, 0 to 4 percent slopes, 2,800 feet south and 100 feet west of the northeast corner of sec. 28, T. 7 S., R. 3 W.

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) loamy sand, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; neutral; abrupt smooth boundary.

Bw—10 to 24 inches; brown (10YR 5/3) loamy sand; common medium faint dark yellowish brown (10YR 4/4) and common medium distinct yellowish brown (10YR 5/6) and dark yellowish brown (10YR 4/6) mottles; weak medium subangular blocky structure; friable; neutral; clear smooth boundary.

E and Bt1—24 to 35 inches; light yellowish brown (10YR 6/4) sand (E); stripped sand grains; single grain; loose; lamellae of yellowish brown (10YR 5/4) loamy sand ⅛ inch to 2 inches thick (Bt); many distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure in the thicker bands; friable; discontinuous clay bridging between sand grains; neutral; clear smooth boundary.

E and Bt2—35 to 60 inches; light yellowish brown (10YR 6/4) sand (E); stripped sand grains; single grain; loose; lamellae of yellowish brown (10YR 5/4) loamy sand ⅛ inch to 2 inches thick (Bt); common fine distinct light brownish gray (10YR 6/2) and few fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure in the thicker bands; friable; discontinuous clay bridging between sand grains; neutral.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. It is loamy sand.

The B horizon has hue of 10YR, value of 5 or 6, and chroma of 4 to 6. It is loamy sand or sand.

The Bt part of the E and Bt horizon consists of lamellae that have hue of 10YR or 7.5YR and value and chroma of 4 to 6. They are sandy loam or loamy sand. The E part of the E and Bt horizon has hue of 10YR, value of 5 or 6, and chroma of 4. It is sand or loamy sand. The bands or lamellae are ¼ inch to 3 inches thick and have a total thickness of 6 inches or more within a depth of 60 inches.

Wallkill Series

The Wallkill series consists of very deep, very poorly drained soils in closed depressions on ground moraines and end moraines. These soils formed in loamy alluvium deposits over organic material. Permeability is moderate in the upper part and moderately rapid in the lower part. Slopes range from 0 to 2 percent.

Typical pedon of Wallkill silt loam, 180 feet west and 2,100 feet north of the southeast corner of sec. 12, T. 8 S., R. 1 W.

A—0 to 6 inches; very dark brown (10YR 2/2) silt loam; moderate medium granular structure; friable; neutral; clear wavy boundary.

Bg—6 to 25 inches; dark grayish brown (2.5Y 4/2) silt loam; common medium distinct dark gray (10YR 4/1) and common fine prominent strong brown (7.5YR 5/6) mottles; moderate fine angular blocky structure; friable; neutral; clear wavy boundary.

Cg—25 to 34 inches; grayish brown (2.5Y 5/2) silt loam common medium distinct gray (10YR 5/1) and few fine prominent strong brown (7.5YR 5/6) mottles; massive; friable; neutral; abrupt smooth boundary.

2Oa—34 to 49 inches; muck, black (2.5Y 2/0) broken face and rubbed; about 10 percent fiber, 2 percent

rubbed; slightly acid; gradual wavy boundary.
2Oe—49 to 60 inches; mucky peat, very dark brown (10YR 2/2) broken face and rubbed; about 60 percent fiber, about 20 percent rubbed; slightly acid.

The thickness of the mineral soil over the organic material ranges from 16 to 40 inches.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is silt loam.

The Bg horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is silt loam.

The Cg horizon has the same colors and textures as the Bg horizon.

The 2O horizons have hue of 7.5YR to 2.5Y or are neutral in hue. They have value of 2 or 3 and chroma of 0 to 2. They consist of hemic or sapric material.

Williamstown Series

The Williamstown series consists of very deep, moderately well drained soils on ground moraines and end moraines. These soils formed in loamy glacial till. Permeability is moderately slow. Slopes range from 2 to 6 percent.

Typical pedon of Williamstown loam, in an area of Williamstown-Conover complex, 1 to 6 percent slopes; in an area where the slope is 3 percent; 2,075 feet east and 525 feet north of the center of sec. 24, T. 7 S., R. 3 W.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; strong medium granular structure; firm; about 5 percent gravel; neutral; abrupt smooth boundary.
Bt1—10 to 15 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium angular blocky structure; firm; common faint dark grayish brown (10YR 4/2) clay films on faces of peds; about 3 percent gravel; neutral; clear wavy boundary.
Bt2—15 to 25 inches; dark yellowish brown (10YR 4/4) clay loam; few fine distinct dark yellowish brown (10YR 4/6) and grayish brown (10YR 5/2) mottles; moderate medium angular blocky structure; very firm; many faint dark grayish brown (10YR 4/2) clay films on faces of peds; about 3 percent gravel; neutral; clear wavy boundary.
Bt3—25 to 33 inches; dark brown (10YR 4/3) clay loam; few fine faint grayish brown (10YR 5/2), few fine prominent yellowish brown (10YR 5/8), and common fine faint dark grayish brown (10YR 4/2) mottles; moderate medium angular blocky structure; very firm; common faint dark grayish brown (10YR 4/2) clay films on faces of peds; about 3 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.
Bk—33 to 60 inches; brown (10YR 5/3) loam; few fine faint dark brown (10YR 4/3) mottles; strong coarse subangular blocky structure; very firm; light gray (10YR 7/2) lime masses and streaks; about 5 percent gravel; strongly effervescent; slightly alkaline.

The thickness of the solum ranges from 30 to more than 60 inches. The depth to free carbonates ranges from 27 to 35 inches. The content of gravel and cobbles ranges from 3 to 5 percent throughout the profile.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is loam.

The B horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. It is loam or clay loam.

Some pedons have a C horizon. This horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. It is loam.

Wolcott Series

The Wolcott series consists of very deep, very poorly drained soils in depressions and on ground moraines. These soils formed in loamy glacial till. Permeability is moderate. Slopes range from 0 to 2 percent.

Typical pedon of Wolcott silt loam, 350 feet west and 2,700 feet south of the northeast corner of sec. 18, T. 7 S., R. 1 W.

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) silt loam, dark gray (10YR 4/1) dry; moderate medium granular structure; friable; about 1 percent gravel; neutral; gradual wavy boundary.
A—10 to 20 inches; very dark gray (10YR 3/1) silty clay loam; moderate medium subangular blocky structure; very firm; about 2 percent gravel; slightly alkaline; clear irregular boundary.
Bg—20 to 32 inches; gray (N 5/0) clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; very firm; about 5 percent gravel; slightly alkaline; gradual wavy boundary.
BC—32 to 38 inches; dark yellowish brown (10YR 4/4) clay loam; common coarse prominent gray (2.5Y 5/2) and common medium prominent yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; common fine irregular lime masses; about 5 percent gravel; strongly effervescent; moderately alkaline; gradual wavy boundary.
C—38 to 60 inches; dark yellowish brown (10YR 4/4) loam; many coarse prominent gray (N 5/0) mottles; massive; firm; violently effervescent; moderately alkaline.

The thickness of the solum ranges from 32 to 45

inches. The content of gravel and cobbles ranges from 1 to 5 percent in the A horizon and from 5 to 10 percent in the B horizon.

The Ap and A horizons have hue of 10YR, value of 2 or 3, and chroma of 1 or 2. They are silt loam.

The B horizon has hue of 10YR or 2.5Y or is neutral in hue. It has value of 4 or 5 and chroma of 0 to 2. It is clay loam.

The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 or 4, or it is neutral in hue and has value of 4 or 5.

Formation of the Soils

The paragraphs that follow relate the factors of soil formation to the soils in Hillsdale County and describe the processes of soil formation.

Factors of Soil Formation

Soil forms through the interaction of five major factors: the physical, chemical, and mineralogical composition of the parent material; the climate under which the soil material has accumulated and existed since accumulation; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time that the processes of soil formation have acted on the parent material (Jenny, 1941). Human activity has also affected the formation of the soils in Hillsdale County.

The factors of soil formation are so closely interrelated in their effects on the soils that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four.

Climate and plant and animal life are the active forces in soil formation. They slowly change the parent material into a natural body of soil that has genetically related layers, called horizons. The effects of climate and plant and animal life are conditioned by relief. The nature of the parent material affects the kind of soil profile that forms and, in extreme cases, determines the soil profile almost entirely. Finally, time is needed for changing the parent material into a soil. Some time is always needed for the differentiation of soil horizons.

Parent Material

Parent material is the unconsolidated mass in which a soil forms. It determines the limits of the chemical and mineralogical composition of the soil. The dominant parent material of the soils in Hillsdale County is glacial till.

Glacial till is unsorted material transported and deposited directly by glaciers with a minimum of water action. It is a mixture of all sizes of particles, from clay-sized particles to large stones and boulders. The coarse fragments in glacial till have sharp corners, indicating that they have not been worn by water. All exposed glacial till in Hillsdale County is a result of the Wisconsin glacial advance. The ice melted and receded from the survey area between 10,000 and 12,000 years ago.

Glacial till is the parent material of about 54 percent of the soils in the survey area. The sandy loam till of the Tekonsha and Kalamazoo Moraines, deposited by the Saginaw Lobe, is the primary parent material of the Hillsdale and Riddles soils. This till has about 5 to 7 percent gravel, 60 percent sand, 30 percent silt, and 10 percent clay. The calcium carbonate equivalent is about 25 percent. The till is friable and is yellowish brown and strong brown.

The loam till of the Mississinewa Moraine, deposited by the Huron-Erie Lobe, is the primary parent material of the Miami soils. This till has about 5 percent gravel, 50 percent sand, 35 percent silt, and 15 percent clay. The calcium carbonate equivalent is about 29 percent. The till is firm and is yellowish brown and brown.

The clay loam till of the Wabash and Fort Wayne Moraines, deposited by the Erie Lobe, is the primary parent material of the Morley soils. This till has less than 5 percent gravel, about 21 percent sand, 45 percent silt, and 34 percent clay. The calcium carbonate equivalent is about 17 percent. The till is very firm and is yellowish brown and brown.

Glacial outwash is the parent material of about 25 percent of the soils in the survey area. It consists of material that was deposited by the glacial meltwaters and is located on the outwash plains, terraces, and kames throughout the county. The texture of this poorly graded material ranges greatly. The size of the particles varies according to the speed of the stream that carried them. As the water slowed, the coarser particles were deposited. Only the finer particles, such as silt and clay, can be carried by slowly moving water.

Outwash soils generally consist of a loamy layer that is underlain by calcareous coarse sand and gravel. The coarse fragments in outwash are typically rounded and have no sharp edges. Outwash deposits, whether they are loamy material or sandy and gravelly material,

generally consist of groups of particles of similar size, such as coarse silt, coarse sand, and gravel. In Hillsdale County, the outwash includes sand, the dominant material of the Coloma soils; sandy loam high in coarse sand and very coarse sand, the dominant material of the Fox soils; and the loamy-skeletal material of the Leoni soils.

Alluvium is the parent material of about 1 percent of the soils in the survey area. This material varies in texture, depending on the source of the material and the speed of the water by which it was deposited. Alluvium deposited by a swift stream is typically sandy or gravelly and is coarser textured than the silt and clay deposited by a slow, sluggish stream. Alluvium has been deposited in various areas on present flood plains, such as natural levees and first and second bottom lands. The soils that formed in alluvium are the youngest soils and typically show no horizon development. Sloan soils formed in loamy alluvium, and Glendora soils formed in sandy alluvium. These soils are characterized by an irregular decrease in content of organic matter with increasing depth.

Residuum is material that weathered in place from sedimentary rocks. In most areas in Hillsdale County, glacial till covers the bedrock. Soils that formed at least partly in residuum make up a very small percentage of the soils in the area. The Marshall Sandstone Formation is the only bedrock that is exposed or close to the surface. This rock weathers into loamy fine sand. It is the parent material of the lower part of the Eleva soils.

Eolian sand is not extensive in Hillsdale County. It occurs in deposits along the major rivers in the county. Other areas of eolian sand occur as low dunes on glaciated uplands. In these areas the sand is underlain by till. Wind-deposited sand is mainly fine and medium quartz that is highly resistant to weathering. Spinks soils and some Coloma soils formed mainly in wind-deposited sands.

Organic material is made up of the remains of decomposed plant materials. After the glaciers receded from the survey area, water remained standing in closed depressions on outwash plains, ground moraines, and end moraines. The water-tolerant grasses, sedges, and trees that grew around the edges of these depressions did not rapidly decompose after they died. Eventually the plant remains filled the depressions and slowly decomposed enough to form muck. Houghton soils are examples of soils that formed in organic materials.

Climate

The soils in Hillsdale County probably formed under a midcontinental humid climate very similar to that of the present. The major influence this climate had on soil formation is its effect on the type of vegetation. In this survey area, the climate favored forest growth.

Climate also has an effect on soil temperature and moisture and thus affects the chemical and biological processes of soil formation. The soil temperature regime in the survey area is mesic, which means that at a depth of 20 inches the soil temperature is between 47 and 49 degrees F. Presuming the soil temperature is an average of 2 degrees warmer than the mean annual air temperature, the soil temperature can be determined without direct measurement. In Hillsdale County, the soil temperature is estimated to be about 48 degrees F in an average year. The primary soil moisture regime in the survey area is udic, which implies that the precipitation is evenly distributed throughout the year and that water moves down through the soil and into the substratum at some time in most years. The survey area also includes an aquic moisture regime, which means that the soils are saturated to the surface during wet parts of the year and for significant periods in the subsoil and substratum during other parts of the growing season. This moisture regime can be identified by the presence of low-chroma mottles, hydrophytic vegetation, and standing water.

Climate is a major factor in determining the extent of soil formation. It affects the rate and intensity of hydrolysis, carbonation, oxidation, reduction, and other important chemical reactions in the soil. Soil temperature and soil moisture relationships as affected by rainfall determine the leaching of carbonates and the translocation of soil minerals and clay. All climatic factors affect the type and abundance of native vegetation, which also affect the soil-forming processes.

Local conditions can somewhat modify or ameliorate the effect of the general climate. The microclimate of south-facing slopes is generally warmer and less humid than that of north-facing slopes. Also, areas close to large bodies of water have less drastic temperature variations and are more humid than areas some distance away. Low lying, poorly drained areas are wetter and colder than most higher areas around them.

Plant and Animal Life

Plant and animal life has had an important impact on the soil formation and degradation in Hillsdale County. Plant life is one of the driving forces in soil formation. As plants grow old and die, their remains accumulate on the surface. They decay and eventually become organic matter and release the stored nutrients to the upper layers of the soil. Grasses have large, fibrous root systems that add large amounts of organic matter to the surface layer yearly. Trees have deep root

systems that recycle nutrients back to the surface from deep in the soil profile. Leachates from leaves contain strong organic acids that break down carbonates and clay minerals. The roots of the plants provide channels for downward movement of water through the soil and provide organic matter as they decay. Earthworms perform a similar function. Their burrows act as large pores that allow water and air movement in the soil. Bacteria and fungi in the soil help to break down the organic matter, thus creating humus and at the same time releasing nutrients that are used by growing plants.

Most of the soils in the survey area have formed under a deciduous forest plant community. Differences in natural soil drainage and minor changes in parent material affected the species composition of the forests. In general, the well drained Fox, Hillsdale, and Miami soils were covered with sugar maple, oak, and hickory. The primary tree species on Spinks and Coloma soils was scrub black oak. The surface layer of soils that formed under forest cover is thin or light in color because of the low percentage of well decomposed humus and the different kinds of humus than would have formed under prairie grass vegetation. The poorly drained and very poorly drained Pewamo, Sebewa, and Gilford soils were covered by red maple, American elm, and white ash. These soils have a thick, dark surface layer. Excess water supported a forest overstory with a lush undergrowth of grasses, forbs, and shrubs. The lack of oxygen caused by saturated conditions reduces the rate of decomposition, thus allowing the organic matter to accumulate.

Human Activity

Human activity has had a tremendous impact on the soil resource in Hillsdale County since the area was settled. Recent activities have augmented or disrupted the natural systems and in general increased the rate at which organic matter decays. The clearing of the timber removed and changed the protective plant cover. Cultivation increased the susceptibility of the soils to erosion by wind and water. When land is brought under cultivation, the runoff rate increases and the infiltration rate decreases. As a result, accelerated erosion removes all or part of the original surface layer along with its organic matter and nutrients. Sheet erosion, which is the most prevalent type of erosion in the county, causes the removal of a thin layer of soil across entire fields and is difficult to observe directly. Cultivation generally removes all traces of this type of erosion and of some rill erosion, but the effects of the erosion still remain. In some areas, deep gullies have formed and the eroded soil material has been deposited on the lower slopes.

Cultivation and erosion have changed the structure and consistence of the surface layer of many soils and reduced the organic matter content and natural fertility. In eroded areas of Morley soils, the plow layer includes the upper part of the subsoil. This plow layer is less friable than the original surface layer and is finer in texture. Compaction by tillage equipment restricts root penetration and water infiltration by compacting the plow layer and the upper part of the subsoil. In heavily compacted areas, a plowpan has formed. The formation of a plowpan is most common in the finer textured soils if they are cultivated during periods when soil moisture is not optimal. Working the soil when it is too wet also increases the puddling of water and crusting of the soil surface. Soil amendments have changed the chemical balance of most soils. Lime, fertilizer, herbicides, and pesticides all affect the kinds and amounts of cations and anions now stored in the soil.

Topography

The topography or relief of the survey area indirectly affects soil formation through its effect on drainage, the rate of geologic erosion, the kind of plant cover, and the soil temperature. The county is dominated by a topography of glacial moraines. In the southeastern half of the county, there is a mixture of slopes ranging from nearly level to very steep. These slopes are dominantly complex in nature with numerous small closed depressions. The northwestern half of the county is also nearly level to very steep; however, the slopes tend to be simple and natural drainageways are more abundant. Soil temperatures are lower on north-facing slopes that receive less direct solar radiation and in low areas that receive cold air drainage.

The color of the subsoil is affected by natural drainage. Water runs off the steeper soils. Also, the steeper soils are generally deeper over the water table. Colors are yellowish brown and brown in the well drained Hillsdale, Riddles, Miami, and Morley soils, all of which have a water table below a depth of 6 feet. The nearly level soils and those in closed depressions have excess water and may be temporarily ponded. These soils also have a water table close to the surface. Colors are dominantly gray in the very poorly drained Wolcott and Pewamo soils. These soils are subject to ponding and have a seasonal high water table at or above the surface. The moderately well drained Williamstown and Glynwood soils are brown and mottled in the subsoil. The somewhat poorly drained Conover, Blount, and Locke soils are grayish brown and mottled in the subsoil. The gray colors are caused when the iron in the soil is in the reduced state because of a lack of oxygen. Oxidized iron is bright red.

The mottles are caused when part of the soil is saturated with water (and thus has no oxygen) and part is aerated. The wetter soils also are darker in the surface layer because of an accumulation of organic matter.

Soils in outwash areas also follow a pattern whereby the steeper soils are better drained than the level soils; however, the influence of the porous, rapidly permeable parent material can override the influence of topography. Even the nearly level Fox and Boyer soils are well drained and brightly colored because permeability is moderately rapid in the subsoil and rapid in the substratum.

Some of the properties of the well drained soils that have a wide slope range are affected by these slopes. Two of these factors are the depth to free carbonates and the depth to the maximum clay percentage in the subsoil. These depths decrease as slope increases, mainly because of the amount of runoff versus deep percolation of warm-season precipitation.

Time

Time is needed for the various processes of soil formation to take effect. Only a few decades may be needed to form a thin A horizon in a soil that formed in a recent alluvial deposit, such as Sloan silt loam. Conversely, thousands of years are needed for the development of argillic subsoil horizons in early Holocene soils, such as Miami loam. Soils on actively aggrading surfaces constantly receive fresh alluvium during each flooding event. This material has not been in place long enough for the climate and vegetation to form well defined genetic horizons. Soils on stable surfaces are subject to long repetitive cycles of soil formation that reflect the maximum changes possible in that soil climate.

Processes of Soil Formation

The processes responsible for the development of soil horizons in the unconsolidated parent material are referred to as soil genesis. The observable or measurable physical, chemical, and biological properties of the horizons are referred to as soil morphology. Horizon differentiation is the result of four basic processes modified by the five factors of soil formation. These processes are additions, removals, transfers, and transformations. In most of the soils, more than one of these processes has been active in the development of horizons. Each of these processes affects many substances in the soil, including organic matter content, soluble salts, carbonates, sesquioxides, and silicate clay. Changes brought about by these various processes help to determine the soil profile at any given site.

The addition of organic matter is an early phase in soil development. It is affected by the age of the soil, the drainage characteristics, the kind of vegetation the soil supports, and the volume of biomass produced. The content of organic matter in the soils of Hillsdale County ranges from very low to very high. The organic matter content is very low in the thin A horizon of Coloma sand. This soil is not very productive. It is excessively drained, and any organic matter present is rapidly decomposed. The organic matter content is high in Pewamo silt loam. This poorly drained soil is very productive. The poor drainage reduces the rate at which the organic matter decomposes. Erosion can also affect the rate of organic matter accumulation. The content is lower in areas where there is a loss of topsoil and is higher at the site of deposition.

The removal and translocation of substances from one part of the profile to another have resulted in differentiated horizons in most of the soils in the county. All factors being favorable, over time, soluble minerals, salts, and carbonates are leached downward into the profile. The carbonates have been completely removed from the upper horizons of all of the soils in the county. In some soils they have been deposited lower in the profile and have become Bk horizons. In the lower subsoil horizons of many soils, some carbonates still remain. After the carbonates are leached from the soil profile and there is no longer an excess of positively charged cations, the negatively charged silicate clay particles can be translocated downward in solution. When most of the soluble minerals and clay have been leached from a layer in the soil, that layer becomes an eluviated horizon, or an E horizon. Simultaneously, the translocated clay accumulates as clay films in pores and on the faces of peds in lower horizons, forming an illuviated argillic horizon. Morley soils are examples of soils in which translocated silicate clay minerals are evident in the subsoil in the form of clay films.

Transformations can be physical or chemical in nature. An example of a physical transformation is the weathering of soil particles to smaller sizes, for instance, the weathering of sandstone bedrock into the loamy sand in the lower part of Eleva soils. An example of a chemical transformation is the reduction of iron from the ferric or oxidized state to the ferrous or reduced state. This process is called gleying. It can occur when the soil becomes saturated for long periods. Anaerobic conditions caused by very low oxygen in the soil allow the reduction of iron. The reduced color of iron is gray. Grayish colors are characteristic of poorly drained soils, such as Wolcott soils.

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Glossary

Ablation till. Loose, permeable till deposited during the final downwasting of glacial ice. Lenses of crudely sorted sand and gravel are common.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Back slope. The geomorphic component that forms the steepest inclined surface and principal element of many slopes. Back slopes in profile are commonly steep and linear and descend to a foot slope.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Broad plains. Extensive areas of nearly level and gently sloping or undulating landscapes with low relief.

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.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2

millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles 2 millimeters to 38 centimeters (15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops

unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Fine textured soil. Sandy clay, silty clay, or clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in

diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of the material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low

0.4 to 0.75 ..... moderately low
0.75 to 1.25 ..... moderate
1.25 to 1.75 ..... moderately high
1.75 to 2.5 ..... high
More than 2.5 ..... very high

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:
Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.
Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.
Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.
Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.
Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.
Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.
Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.
Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.
Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Knoll. A small, low, rounded hill rising above adjacent nearly level areas.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Levee. An artificial or natural embankment built along the margin of a watercourse or an arm of the sea to protect land from inundation or to confine streamflow to its channel.

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.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Muck. Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Mucky peat. Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Ridge. A long, narrow elevation of the land surface, generally sharp crested with steep sides and forming an extended upland between valleys.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream

channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called groundwater 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.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shoulder slope. The geomorphic component that forms the uppermost inclined surface at the top of a hillslope. It comprises the transition zone from back slope to summit of an upland.

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.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey, classes for simple slopes are as follows:

Nearly level	0 to 2 percent
Nearly level and gently sloping	1 to 6 percent
Moderately sloping	6 to 12 percent
Strongly sloping	12 to 18 percent
Moderately steep	18 to 25 percent
Steep	25 to 35 percent

Classes for complex slopes are as follows:

Nearly level	0 to 2 percent
Nearly level and undulating	1 to 6 percent
Gently rolling	6 to 12 percent
Rolling	12 to 18 percent
Hilly	18 to 25 percent
Steep	25 to 35 percent

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of

the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind erosion and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). A layer of otherwise suitable soil material that is too thin for the specified use.

Till plain. An extensive area of nearly level to undulating soils underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-80 at Hillsdale, Michigan)

Month	Temperature						Precipitation				
				2 years in 10 will have--		Average		2 years in 10 will have--		Average	
	Average daily maximum	Average daily minimum	Average	Maximum temperature higher than--	Minimum temperature lower than--	number of growing degree days*	Average	Less than--	More than--	number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January-----	30.1	14.5	22.3	55	-13	**	2.27	1.16	3.24	7	12.5
February----	33.7	15.8	24.7	57	-13	**	2.01	1.09	2.82	6	11.8
March-------	43.7	24.9	34.3	73	-2	10	3.11	2.06	4.07	8	9.6
April-------	58.4	35.8	47.1	82	15	88	3.73	2.69	4.70	9	2.2
May---------	69.7	45.5	57.6	88	25	273	3.45	2.29	4.50	8	.1
June--------	79.0	54.7	66.8	93	35	513	4.21	2.96	5.37	8	.0
July--------	82.1	58.4	70.2	94	43	636	4.13	2.68	5.44	8	.0
August------	80.6	56.9	68.8	93	38	588	3.26	1.64	4.67	7	.0
September---	73.9	50.0	61.9	92	29	372	2.92	1.54	4.13	6	.1
October-----	62.3	39.8	51.0	84	18	135	2.79	1.39	3.99	6	.3
November----	47.2	30.1	38.6	71	7	19	2.94	1.91	3.87	8	6.6
December----	34.9	19.9	27.4	60	-8	1	2.93	1.49	4.16	7	13.5
Yearly:											
Average---	58.0	37.2	47.6	---	---	---	---	---	---	---	---
Extreme---	---	---	---	95	-15	---	---	---	---	---	---
Total-----	---	---	---	---	---	2,635	37.75	32.80	42.54	88	56.7

* 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 (50 degrees F).

** Less than 0.5.

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1951-80 at Hillsdale, Michigan)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 27	May 17	May 30
2 years in 10 later than--	Apr. 23	May 12	May 24
5 years in 10 later than--	Apr. 14	May 2	May 13
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 7	Sept. 25	Sept. 14
2 years in 10 earlier than--	Oct. 13	Oct. 1	Sept. 19
5 years in 10 earlier than--	Oct. 24	Oct. 12	Sept. 27

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-80 at Hillsdale, Michigan)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	168	142	118
8 years in 10	176	149	124
5 years in 10	192	162	136
2 years in 10	208	175	148
1 year in 10	216	182	155

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
10B	Hillsdale-Riddles complex, 2 to 6 percent slopes	28,036	7.2
10C2	Hillsdale-Riddles complex, 6 to 12 percent slopes, eroded	14,521	3.7
10D2	Hillsdale-Riddles complex, 12 to 18 percent slopes, eroded	2,049	0.5
10E	Hillsdale-Riddles complex, 18 to 35 percent slopes	903	0.2
11B	Eleva channery fine sandy loam, 2 to 6 percent slopes	539	0.1
11C	Eleva channery fine sandy loam, 6 to 12 percent slopes	138	*
11D	Eleva channery fine sandy loam, 12 to 25 percent slopes	148	*
12B	Williamstown-Conover complex, 1 to 6 percent slopes	37,171	9.6
12C2	Miami loam, 6 to 12 percent slopes, eroded	24,341	6.3
12D2	Miami clay loam, 12 to 18 percent slopes, eroded	5,273	1.4
12E	Miami loam, 18 to 35 percent slopes	2,435	0.6
13B	Conover loam, 1 to 4 percent slopes	12,740	3.3
14	Wolcott silt loam	9,262	2.4
15B	Boyer loamy sand, 1 to 6 percent slopes	9,141	2.4
15C	Boyer loamy sand, 6 to 12 percent slopes	5,533	1.4
15D2	Boyer gravelly loamy sand, 12 to 18 percent slopes, eroded	1,303	0.3
15E	Boyer gravelly loamy sand, 18 to 35 percent slopes	932	0.2
16B	Fox sandy loam, 1 to 6 percent slopes	19,019	4.9
16C2	Fox sandy loam, 6 to 12 percent slopes, eroded	13,124	3.4
16D2	Fox gravelly sandy loam, 12 to 18 percent slopes, eroded	3,451	0.9
16E	Fox gravelly sandy loam, 18 to 35 percent slopes	2,173	0.6
17	Sebewa loam	3,824	1.0
18B	Glynwood-Blount complex, 1 to 6 percent slopes	27,143	7.0
18C2	Morley loam, 6 to 12 percent slopes, eroded	13,594	3.5
18D2	Morley clay loam, 12 to 18 percent slopes, eroded	3,723	1.0
18E	Morley loam, 18 to 35 percent slopes	1,554	0.4
19B	Blount silt loam, 0 to 4 percent slopes	21,689	5.6
20	Pewamo silt loam	8,785	2.3
24B	Spinks loamy sand, 0 to 6 percent slopes	4,607	1.2
24C	Spinks loamy sand, 6 to 12 percent slopes	2,126	0.5
24D	Spinks loamy sand, 12 to 18 percent slopes	877	0.2
25B	Thetford loamy sand, 0 to 4 percent slopes	2,533	0.7
29B	Steamburg sandy loam, 2 to 6 percent slopes	1,774	0.5
29C	Steamburg sandy loam, 6 to 12 percent slopes	953	0.2
29D	Steamburg sandy loam, 12 to 18 percent slopes	160	*
32	Sloan silt loam, frequently flooded	6,322	1.6
33	Houghton muck	21,804	5.6
34	Adrian muck	1,664	0.4
35	Palms muck	2,650	0.7
37A	Matherton loam, 0 to 3 percent slopes	8,891	2.3
38	Edwards muck	1,311	0.3
39	Gilford sandy loam	2,611	0.7
40A	Locke fine sandy loam, 0 to 3 percent slopes	9,106	2.3
42B	Riddles sandy loam, 2 to 6 percent slopes	15,447	4.0
42C2	Riddles sandy loam, 6 to 12 percent slopes, eroded	4,491	1.2
42D2	Riddles sandy loam, 12 to 18 percent slopes, eroded	595	0.2
42E	Riddles sandy loam, 18 to 35 percent slopes	120	*
43	Histosols and Aquents, ponded	2,199	0.6
44B	Leoni gravelly sandy loam, 1 to 6 percent slopes	2,335	0.6
44C2	Leoni very gravelly sandy loam, 6 to 12 percent slopes, eroded	1,420	0.4
44D2	Leoni very gravelly sandy loam, 12 to 18 percent slopes, eroded	320	0.1
45	Napoleon muck, ponded	38	*
46	Wallkill silt loam	33	*
50B	Coloma sand, 0 to 6 percent slopes	5,926	1.5
50C	Coloma sand, 6 to 18 percent slopes	4,241	1.1
50E	Coloma sand, 18 to 35 percent slopes	820	0.2
51	Glendora mucky loamy sand, frequently flooded	2,566	0.7
55	Pits, gravel	1,135	0.3
57	Shoals loam, occasionally flooded	17	*
58B	Seward loamy sand, 0 to 4 percent slopes	213	0.1
	Water areas less than 40 acres in size	6,317	1.6
	Total	388,166	100.0

* Less than 0.1 percent.

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
10B	Hillsdale-Riddles complex, 2 to 6 percent slopes
12B	Williamstown-Conover complex, 1 to 6 percent slopes (where drained)
13B	Conover loam, 1 to 4 percent slopes (where drained)
14	Wolcott silt loam (where drained)
16B	Fox sandy loam, 1 to 6 percent slopes
17	Sebewa loam (where drained)
18B	Glynwood-Blount complex, 1 to 6 percent slopes (where drained)
19B	Blount silt loam, 0 to 4 percent slopes (where drained)
20	Pewamo silt loam (where drained)
29B	Steamburg sandy loam, 2 to 6 percent slopes
32	Sloan silt loam, frequently flooded (where drained and either protected from flooding or not frequently flooded during the growing season)
37A	Matherton loam, 0 to 3 percent slopes (where drained)
39	Gilford sandy loam (where drained)
40A	Locke fine sandy loam, 0 to 3 percent slopes (where drained)
42B	Riddles sandy loam, 2 to 6 percent slopes
57	Shoals loam, occasionally flooded (where drained)

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS

(Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability		Corn		Corn silage		Winter wheat		Oats		Soybeans		Alfalfa hay	
	N	I	N	I	N	I	N	I	N	I	N	I	N	I
			Bu	Bu	Tons	Tons	Bu	Bu	Bu	Bu	Bu	Bu	Tons	Tons
10B---------- Hillsdale-Riddles	IIe	---	110	---	18	---	48	---	80	---	40	---	4.0	---
10C2---------- Hillsdale-Riddles	IIIe	---	90	---	13	---	40	---	70	---	35	---	3.6	---
10D2---------- Hillsdale-Riddles	IVe	---	74	---	---	---	33	---	60	---	22	---	3.2	---
10E---------- Hillsdale-Riddles	VIe	---	---	---	---	---	---	---	---	---	---	---	3.0	---
11B---------- Eleva	IIIs	---	---	---	---	---	---	---	---	---	---	---	4.5	---
11C---------- Eleva	IVe	---	---	---	---	---	---	---	---	---	---	---	4.2	---
11D---------- Eleva	VIe	---	---	---	---	---	---	---	---	---	---	---	4.0	---
12B---------- Williamstown-Conover	IIe	---	120	---	---	---	54	---	85	---	42	---	3.8	---
12C2---------- Miami	IIIe	---	95	---	---	---	43	---	---	---	33	---	3.1	---
12D2---------- Miami	IVe	---	80	---	---	---	36	---	---	---	28	---	2.6	---
12E---------- Miami	VIe	---	---	---	---	---	---	---	---	---	---	---	---	---
13B---------- Conover	IIe	---	120	---	18	---	60	---	100	---	36	---	5.0	---
14---------- Wolcott	IIw	---	150	---	---	---	60	---	---	---	53	---	---	---
15B---------- Boyer	IIIs	---	80	---	14	---	35	---	60	---	30	---	3.4	---
15C---------- Boyer	IIIe	---	75	---	12	---	32	---	55	---	26	---	2.8	---
15D2---------- Boyer	IVe	---	60	---	10	---	23	---	45	---	18	---	2.2	---
15E---------- Boyer	VIe	---	---	---	---	---	---	---	---	---	---	---	1.6	---
16B---------- Fox	IIe	---	95	---	15	---	42	---	75	---	30	---	4.5	---

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability		Corn		Corn silage		Winter wheat		Oats		Soybeans		Alfalfa hay	
	N	I	N	I	N	I	N	I	N	I	N	I	N	I
			Bu	Bu	Tons	Tons	Bu	Bu	Bu	Bu	Bu	Bu	Tons	Tons
16C2---------- Fox	IIIe	---	80	---	12	---	30	---	62	---	---	---	2.6	---
16D2---------- Fox	IVe	---	65	---	---	---	25	---	55	---	---	---	2.0	---
16E---------- Fox	VIe	---	---	---	---	---	25	---	55	---	---	---	2.0	---
17---------- Sebewa	IIw	---	115	---	19	---	55	---	95	---	36	---	---	---
18B---------- Glynwood-Blount	IIe	---	120	---	---	---	50	---	72	---	42	---	4.5	---
18C2---------- Morley	IIIe	---	97	---	---	---	44	---	60	---	33	---	4.0	---
18D2---------- Morley	IVe	---	87	---	---	---	39	---	54	---	---	---	3.9	---
18E---------- Morley	VIe	---	---	---	---	---	---	---	---	---	---	---	3.1	---
19B---------- Blount	IIe	---	115	---	---	---	47	---	63	---	40	---	4.3	---
20---------- Pewamo	IIw	---	130	---	20	---	60	---	100	---	42	---	---	---
24B---------- Spinks	IIIs	IIe	75	165	13	24	30	---	60	---	27	50	3.0	---
24C---------- Spinks	IIIe	IIIe	68	155	12	23	30	---	55	---	23	50	2.4	---
24D---------- Spinks	IVe	---	---	---	---	---	24	---	50	---	---	---	1.8	---
25B---------- Thetford	IIIw	---	85	148	14	22	35	---	65	---	32	---	3.8	---
29B---------- Steamburg	IIs	---	105	---	17	---	55	---	80	---	35	---	4.5	---
29C---------- Steamburg	IIIe	---	90	---	16	---	50	---	75	---	33	---	4.0	---
29D---------- Steamburg	IVe	---	80	---	12	---	45	---	70	---	30	---	3.7	---
32---------- Sloan	IIIw	---	110	---	---	---	---	---	---	---	35	---	4.0	---
33---------- Houghton	Vw	---	---	---	---	---	---	---	---	---	---	---	---	---
34---------- Adrian	Vw	---	---	---	---	---	---	---	---	---	---	---	---	---
35---------- Palms	Vw	---	---	---	---	---	---	---	---	---	---	---	---	---

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability		Corn		Corn silage		Winter wheat		Oats		Soybeans		Alfalfa hay	
	N	I	N	I	N	I	N	I	N	I	N	I	N	I
			Bu	Bu	Tons	Tons	Bu	Bu	Bu	Bu	Bu	Bu	Tons	Tons
37A---------- Matherton	IIw	---	110	---	18	---	45	---	90	---	36	---	4.5	---
38---------- Edwards	Vw	---	---	---	---	---	---	---	---	---	---	---	---	---
39---------- Gilford	IIIw	---	90	---	1.5	---	45	---	75	---	42	---	---	---
40A---------- Locke	IIw	---	105	---	17	---	45	---	80	---	36	---	4.0	---
42B---------- Riddles	IIe	---	120	---	20	---	50	---	80	---	40	---	3.8	---
42C2---------- Riddles	IIIe	---	105	---	19	---	45	---	70	---	35	---	3.4	---
42D2---------- Riddles	IVe	---	85	---	---	---	38	---	60	---	30	---	3.0	---
42E---------- Riddles	VIe	---	---	---	---	---	---	---	---	---	---	---	2.5	---
43. Histosols and Aquents														
44B---------- Leoni	IIIs	IIe	85	120	19	25	40	45	60	---	30	---	2.5	---
44C2---------- Leoni	IIIe	IIIe	75	115	15	21	25	29	52	---	25	---	2.2	---
44D2---------- Leoni	IVe	---	60	---	13	---	20	---	45	---	---	---	1.5	---
45---------- Napoleon	VIw	---	---	---	---	---	---	---	---	---	---	---	---	---
46---------- Wallkill	Vw	---	---	---	---	---	---	---	---	---	---	---	---	---
50B---------- Coloma	IVs	IIIe	45	170	7	---	---	---	45	---	18	55	2.5	---
50C---------- Coloma	VIs	---	---	---	---	---	---	---	---	---	---	---	---	---
50E---------- Coloma	VIIs	---	---	---	---	---	---	---	---	---	---	---	---	---
51---------- Glendora	VIw	---	---	---	---	---	---	---	---	---	---	---	---	---
55. Pits														
57---------- Shoals	IIw	---	130	---	---	---	52	---	---	---	46	---	---	---

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability		Corn		Corn silage		Winter wheat		Oats		Soybeans		Alfalfa hay	
	N	I	N	I	N	I	N	I	N	I	N	I	N	I
			Bu	Bu	Tons	Tons	Bu	Bu	Bu	Bu	Bu	Bu	Tons	Tons
58B---------- Seward	IIs	---	90	---	---	---	38	---	75	---	32	---	4.2	---

TABLE 7.--CAPABILITY CLASSES AND SUBCLASSES

(Miscellaneous areas are excluded. Absence of an entry indicates no acreage)

Class	Total acreage	Major management concerns (Subclass)		
		Erosion (e)	Wetness (w)	Soil problem (s)
		Acres	Acres	Acres
I	---	---	---	---
II	203,117	161,245	39,885	1,987
III	108,191	80,103	11,466	16,622
IV	23,815	17,889	---	5,926
V	27,462	---	27,462	---
VI	15,110	8,265	2,604	4,241
VII	820	---	---	820
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				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
10B, 10C2, 10D2:									
Hillsdale------	4A	Slight	Slight	Slight	Slight	Northern red oak----	66	60	Black walnut, eastern white pine, white spruce, red pine, yellow-poplar, Carolina poplar.
						White ash----------	---	---	
						Sugar maple---------	---	---	
						Black cherry--------	---	---	
						American basswood---	---	---	
						Yellow-poplar-------	---	---	
Riddles--------	5A	Slight	Slight	Slight	Slight	Northern red oak----	75	73	Black walnut, eastern white pine, red pine, white spruce.
						Red maple----------	75	47	
						White ash----------	75	73	
						Green ash----------	75	73	
						Black walnut--------	---	---	
						Yellow-poplar-------	---	---	
10E:									
Hillsdale------	4R	Moderate	Moderate	Slight	Slight	Northern red oak----	66	60	Black walnut, eastern white pine, white spruce, red pine, yellow-poplar, Carolina poplar.
						White ash----------	---	---	
						Sugar maple---------	---	---	
						Black cherry--------	---	---	
						American basswood---	---	---	
						Yellow-poplar-------	---	---	
Riddles--------	5R	Moderate	Moderate	Slight	Slight	Northern red oak----	75	73	Black walnut, eastern white pine, red pine, white spruce.
						Red maple----------	75	47	
						White ash----------	75	73	
						Green ash----------	75	73	
						Black walnut--------	---	---	
						Yellow-poplar-------	---	---	
11B, 11C-------- Eleva	2D	Slight	Slight	Slight	Moderate	Northern red oak----	50	34	Eastern white pine, red pine.
11D---------- Eleva	2R	Moderate	Moderate	Slight	Moderate	Northern red oak----	50	34	Eastern white pine, red pine.
12B:									
Williamstown---	5A	Slight	Slight	Slight	Slight	Northern red oak----	70	66	Northern red oak, white oak, Norway spruce, yellow-poplar, black walnut.
						Sugar maple---------	---	---	
						Yellow-poplar-------	---	---	
						White oak----------	70	66	
						Black walnut--------	---	---	
						White ash----------	---	---	
						American basswood---	---	---	

See footnote at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
12B:									
Conover	3W	Slight	Severe	Slight	Slight	Northern red oak	55	42	Eastern white pine, black walnut, yellow-poplar.
						White ash	---	---	
						Northern pin oak	---	---	
						Yellow-poplar	---	---	
						Black walnut	---	---	
						Swamp white oak	---	---	
						American sycamore	---	---	
						Red maple	---	---	
12C2, 12D2 Miami	4A	Slight	Slight	Slight	Slight	Northern red oak	69	64	Black walnut, white ash, red pine, eastern white pine.
						White oak	---	---	
						American beech	---	---	
						Sugar maple	---	---	
						White ash	---	---	
12E Miami	4R	Moderate	Moderate	Slight	Slight	Northern red oak	69	64	Black walnut, white ash, red pine, eastern white pine.
						White oak	---	---	
						American beech	---	---	
						Sugar maple	---	---	
						White ash	---	---	
13B Conover	3W	Slight	Severe	Slight	Slight	Northern red oak	55	42	Eastern white pine, black walnut, yellow-poplar.
						White ash	---	---	
						Northern pin oak	---	---	
						Yellow-poplar	---	---	
						Black walnut	---	---	
						Swamp white oak	---	---	
						American sycamore	---	---	
						Red maple	---	---	
14 Wolcott	3W	Slight	Severe	Severe	Severe	Red maple	65	41	---
						Silver maple	---	---	
						White ash	---	---	
						American basswood	---	---	
						American sycamore	---	---	
						Black willow	---	---	
15B, 15C Boyer	4A	Slight	Slight	Slight	Slight	Northern red oak	66	60	Eastern white pine, red pine, northern red oak, white oak.
						White oak	---	---	
						American basswood	---	---	
						Sugar maple	---	---	
						Black oak	---	---	
15D2 Boyer	4A	Slight	Slight	Slight	Slight	Northern red oak	66	60	Eastern white pine, red pine.
						White oak	---	---	
						American basswood	---	---	
						Sugar maple	---	---	
						Black oak	---	---	
15E Boyer	4R	Moderate	Moderate	Slight	Slight	Northern red oak	66	60	Eastern white pine, red pine.
						White oak	---	---	
						American basswood	---	---	
						Sugar maple	---	---	
						Black oak	---	---	

See footnote at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
16B, 16C2---------- Fox	4A	Slight	Slight	Slight	Slight	Northern red oak----	65	59	Norway spruce, white spruce, eastern white pine.
						White oak----------	---	---	
						Sugar maple---------	---	---	
16D2---------- Fox	4A	Slight	Slight	Moderate	Slight	Northern red oak----	65	59	Norway spruce, white spruce, eastern white pine.
						White oak----------	---	---	
						Sugar maple---------	---	---	
16E---------- Fox	4R	Moderate	Moderate	Moderate	Slight	Northern red oak----	80	80	Black walnut, white oak, yellow-poplar, northern red oak, white ash, eastern white pine, red pine.
						White oak----------	---	---	
						Black walnut--------	---	---	
						Black cherry--------	---	---	
						Sugar maple---------	---	---	
						White ash----------	---	---	
						Yellow-poplar-------	---	---	
17---------- Sebewa	3W	Slight	Severe	Severe	Severe	Red maple----------	69	42	White spruce, eastern white pine, white ash.
						White ash----------	69	64	
						American basswood---	---	---	
						Swamp white oak-----	---	---	
						Northern red oak----	---	---	
18B:									
Glynwood-------	3C	Slight	Slight	Severe	Severe	Northern red oak----	55	42	Eastern white pine, white ash, red maple, yellow-poplar.
						Red maple----------	55	35	
						White ash----------	55	42	
						Swamp white oak-----	---	---	
						American beech------	---	---	
Blount---------	3C	Slight	Moderate	Severe	Severe	Northern red oak----	57	46	Eastern white pine, northern whitecedar, white spruce, Norway spruce, yellow-poplar.
						White oak----------	57	46	
						White ash----------	57	46	
						Sugar maple---------	54	34	
18C2, 18D2------ Morley	5A	Slight	Slight	Slight	Slight	White oak----------	70	66	White oak, black walnut, green ash, eastern white pine, Norway spruce, red pine, white spruce.
						Northern red oak----	70	66	
						Black walnut--------	---	---	
						Shagbark hickory----	---	---	
18E---------- Morley	5R	Moderate	Moderate	Slight	Slight	White oak----------	70	66	White oak, black walnut, green ash, eastern white pine, Norway spruce, red pine, white spruce.
						Northern red oak----	70	66	
						Black walnut--------	---	---	
						Shagbark hickory----	---	---	

See footnote at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
19B---------- Blount	3C	Slight	Moderate	Severe	Severe	Northern red oak----	57	46	Eastern white pine, northern whitecedar, white spruce, Norway spruce, yellow-poplar.
						White oak----------	57	46	
						White ash----------	57	46	
						Sugar maple---------	54	34	
20---------- Pewamo	3W	Slight	Severe	Severe	Severe	Red maple----------	66	41	---
						American basswood---	66	60	
						Silver maple--------	---	---	
						White ash----------	---	---	
						Black ash----------	---	---	
						Eastern cottonwood--	---	---	
24B, 24C, 24D--- Spinks	4A	Slight	Slight	Slight	Slight	Northern red oak----	66	60	Red pine, eastern white pine, Carolina poplar.
						White oak----------	---	---	
						Black oak----------	---	---	
						Black cherry--------	---	---	
25B---------- Thetford	3W	Slight	Moderate	Slight	Slight	Red maple----------	65	40	White spruce, eastern white pine.
						White ash----------	---	---	
						Quaking aspen-------	---	---	
						Eastern cottonwood--	---	---	
						Northern red oak----	---	---	
						Swamp white oak-----	---	---	
						Bitternut hickory---	---	---	
29B, 29C, 29D--- Steamburg	4A	Slight	Slight	Slight	Slight	Northern red oak----	65	59	Black walnut, white spruce, white ash, yellow-poplar, eastern white pine.
						Black cherry--------	---	---	
						White ash----------	65	59	
						Sugar maple---------	61	38	
						American basswood---	65	59	
						White oak----------	---	---	
						Yellow-poplar-------	---	---	
32---------- Sloan	3W	Slight	Severe	Moderate	Moderate	Red maple----------	66	41	Black spruce, northern whitecedar, eastern cottonwood.
						Swamp white oak-----	---	---	
						White ash----------	66	60	
						Green ash----------	66	60	
						Eastern cottonwood--	89	100	
						Pin oak------------	---	---	
33---------- Houghton	2W	Slight	Severe	Severe	Severe	Silver maple--------	82	36	---
						Red maple----------	56	36	
						White ash----------	56	44	
						Quaking aspen-------	60	64	
						Tamarack-----------	52	45	
						Green ash----------	---	---	
						Northern whitecedar-	37	55	
34---------- Adrian	2W	Slight	Severe	Severe	Severe	Silver maple--------	78	32	---
						Red maple----------	53	34	
						White ash----------	69	64	
						Quaking aspen-------	60	64	
						Tamarack-----------	45	35	
						Green ash----------	69	64	

See footnote at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
35---------- Palms	2W	Slight	Severe	Severe	Severe	Red maple----------	55	35	Northern whitecedar, tamarack.
						Silver maple--------	80	42	
						White ash----------	---	---	
						Quaking aspen-------	---	---	
						Northern whitecedar-	---	---	
						Tamarack-----------	---	---	
						Black ash----------	---	---	
37A---------- Matherton	4W	Slight	Severe	Slight	Slight	Northern red oak----	62	54	White spruce, Norway spruce, eastern white pine.
						Swamp white oak-----	---	---	
						White oak----------	---	---	
						White ash----------	---	---	
						American basswood---	---	---	
						Red maple----------	---	---	
38---------- Edwards	2W	Slight	Severe	Severe	Severe	Red maple----------	56	36	---
						White ash----------	---	---	
						Green ash----------	---	---	
						Tamarack-----------	---	---	
						Swamp white oak-----	---	---	
						Silver maple--------	---	---	
39---------- Gilford	2W	Slight	Severe	Severe	Severe	Red maple----------	56	36	Eastern white pine, white spruce.
						Silver maple--------	---	---	
						American basswood---	---	---	
						Bur oak------------	---	---	
						White ash----------	---	---	
						Swamp white oak-----	---	---	
40A---------- Locke	4W	Slight	Moderate	Slight	Moderate	Northern red oak----	66	60	White spruce, eastern white pine, Norway spruce, imperial Carolina poplar.
						White oak----------	---	---	
						White ash----------	---	---	
						Red maple----------	---	---	
						American basswood---	---	---	
42B, 42C2, 42D2- Riddles	5A	Slight	Slight	Slight	Slight	Northern red oak----	75	73	Black walnut, eastern white pine, red pine, white spruce.
						Red maple----------	75	47	
						White ash----------	75	73	
						Green ash----------	75	73	
						Black walnut--------	---	---	
						Yellow-poplar-------	---	---	
42E---------- Riddles	5R	Moderate	Moderate	Slight	Slight	Northern red oak----	75	73	Black walnut, eastern white pine, red pine, white spruce.
						Red maple----------	75	47	
						White ash----------	75	73	
						Green ash----------	75	73	
						Black walnut--------	---	---	
						Yellow-poplar-------	---	---	
44B, 44C2, 44D2- Leoni	4A	Slight	Slight	Slight	Slight	Northern red oak----	65	59	Red pine, eastern white pine.
						White oak----------	---	---	
						American basswood---	---	---	
						Sugar maple---------	---	---	
						White ash----------	---	---	
						Black walnut--------	---	---	
						Black cherry--------	---	---	

See footnote at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
45-------------- Napoleon	2W	Slight	Severe	Severe	Severe	Red maple---------- Silver maple-------- White ash---------- Quaking aspen------- Tamarack---------- Black ash---------- Swamp white oak-----	56 --- --- --- --- --- ---	36 --- --- --- --- --- ---	---
46-------------- Wallkill	2W	Slight	Severe	Severe	Severe	Silver maple-------- Black willow--------	70 ---	25 ---	---
50B, 50C-------- Coloma	2S	Slight	Moderate	Moderate	Slight	Northern pin oak---- Jack pine---------- Eastern white pine-- Black oak----------	49 --- --- ---	33 --- --- ---	Red pine, eastern white pine, eastern white pine, jack pine.
50E-------------- Coloma	2R	Moderate	Moderate	Moderate	Slight	Northern pin oak---- Jack pine---------- Eastern white pine-- Black oak----------	49 --- --- ---	33 --- --- ---	Red pine, eastern white pine, eastern white pine, jack pine.
51-------------- Glendora	3W	Slight	Severe	Moderate	Moderate	Silver maple-------- Red maple---------- Swamp white oak----- Quaking aspen------- Black ash---------- Eastern cottonwood-- White ash----------	90 65 --- --- --- --- 65	42 40 --- --- --- --- 59	---
57-------------- Shoals	4W	Slight	Moderate	Moderate	Slight	Northern red oak---- White ash---------- Red maple---------- American basswood--- Eastern cottonwood--	65 --- --- --- ---	59 --- --- --- ---	Eastern white pine, white spruce, yellow-poplar.
58B-------------- Seward	4S	Slight	Slight	Moderate	Slight	Northern red oak---- Red maple---------- Black oak---------- Quaking aspen------- Yellow-poplar------- Green ash----------	65 --- --- --- --- ---	59 --- --- --- --- ---	Eastern white pine, yellow-poplar, red pine, green ash.

* Volume is the yield in cubic feet per acre per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--			
	8-15	16-25	26-35	>35
10B, 10C2, 10D2, 10E:				
Hillsdale	Autumn-olive, lilac, Siberian peashrub.	White spruce, Manchurian crabapple, Austrian pine.	Eastern white pine, red pine, Norway spruce.	Carolina poplar.
Riddles	Silky dogwood, Siberian peashrub, lilac, Amur maple.	Northern whitecedar, Black Hills spruce, Siberian crabapple.	Green ash, Norway spruce, jack pine, red pine, eastern white pine.	---
11B, 11C, 11D---- Eleva	Autumn-olive, eastern redcedar, radiant crabapple, Washington hawthorn, Amur honeysuckle, lilac.	Eastern white pine, Austrian pine, red pine, jack pine.	---	---
12B:				
Williamstown----	Lilac, silky dogwood	Northern whitecedar, blue spruce, nannyberry viburnum, white spruce, Amur maple.	Eastern white pine, Norway spruce, red pine, green ash, Austrian pine.	---
Conover	Lilac, American cranberrybush, silky dogwood, Amur privet.	Manchurian crabapple, white spruce, northern whitecedar.	Eastern white pine, green ash, Norway spruce.	Carolina poplar.
12C2, 12D2, 12E--- Miami	Silky dogwood, lilac, American cranberrybush, northern whitecedar, Amur maple, common ninebark.	Norway spruce, white spruce, Siberian crabapple.	White ash, eastern white pine, red pine.	---
13B---------- Conover	Lilac, American cranberrybush, silky dogwood, Amur privet.	Manchurian crabapple, white spruce, northern whitecedar.	Eastern white pine, green ash, Norway spruce.	Carolina poplar.
14---------- Wolcott	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine----	Pin oak.
15B, 15C---------- Boyer	Amur maple, Siberian peashrub, lilac, Roselow sargent crabapple, Manchurian crabapple.	Red pine, Austrian pine, green ash, eastern redcedar.	Eastern white pine----	---

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--			
	8-15	16-25	26-35	>35
15D2, 15E--------- Boyer	Nannyberry viburnum, lilac, Siberian peashrub, eastern redcedar, Roselow sargent crabapple, Tatarian honeysuckle.	Jack pine, green ash, Austrian pine, Siberian crabapple.	Eastern white pine, red pine.	---
16B, 16C2--------- Fox	Common ninebark, Siberian peashrub, eastern redcedar, lilac, Amur maple, American cranberrybush, silky dogwood, gray dogwood.	Norway spruce---------	Eastern white pine, jack pine.	---
16D2, 16E--------- Fox	Lilac, Amur honeysuckle, autumn-olive, Washington hawthorn, radiant crabapple, eastern redcedar.	Eastern white pine, jack pine, red pine, Austrian pine.	---	---
17---------- Sebewa	Silky dogwood, lilac, Amur privet, American cranberrybush, nannyberry viburnum.	White spruce, northern whitecedar, Manchurian crabapple.	Eastern white pine, Norway spruce, green ash.	Imperial Carolina poplar.
18B: Glynwood---------	Silky dogwood, sargent crabapple, autumn-olive.	White spruce, tall purple willow, northern whitecedar, green ash.	Eastern white pine, Norway spruce.	Carolina poplar.
Blount----------	American cranberrybush, Amur privet, white spruce, late lilac, northern whitecedar.	---	White ash, red pine, eastern white pine, Norway spruce, red maple, silver maple.	Green ash.
18C2, 18D2, 18E--- Morley	Eastern redcedar, lilac, Siberian peashrub, northern whitecedar.	Red pine, hackberry, Russian-olive, white spruce.	Eastern white pine, red maple, green ash, white ash.	---
19B---------- Blount	American cranberrybush, Amur privet, white spruce, late lilac, northern whitecedar.	---	White ash, red pine, eastern white pine, Norway spruce, red maple, silver maple.	Green ash.
20---------- Pewamo	American cranberrybush, silky dogwood, Amur privet, lilac, common ninebark.	Northern whitecedar, Siberian crabapple, white spruce.	Green ash, Norway spruce, eastern white pine.	Imperial Carolina poplar.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--			
	8-15	16-25	26-35	>35
24B, 24C, 24D----- Spinks	American cranberrybush, silky dogwood, lilac, Siberian peashrub, Tatarian honeysuckle.	White spruce, eastern redcedar.	Eastern white pine, red pine, green ash, Norway spruce.	Carolina poplar.
25B---------- Thetford	Silky dogwood, lilac, American cranberrybush.	White spruce, northern whitecedar, Amur maple.	Norway spruce, eastern white pine, green ash.	Imperial Carolina poplar.
29B, 29C, 29D----- Steamburg	Common ninebark, Amur maple, Amur privet, lilac.	---	Red pine, eastern white pine, white spruce, Norway spruce.	Imperial Carolina poplar.
32---------- Sloan	Green ash, silky dogwood, Amur privet, white spruce, American cranberrybush.	Northern whitecedar, Manchurian crabapple.	Golden willow---------	Carolina poplar.
33---------- Houghton	Silky dogwood, lilac, Amur privet, common ninebark, nannyberry viburnum.	Siberian crabapple, northern whitecedar.	Green ash, Norway spruce, eastern white pine.	Imperial Carolina poplar.
34---------- Adrian	Silky dogwood, common ninebark, Amur privet, American cranberrybush, late lilac, Siberian peashrub, nannyberry viburnum.	Northern whitecedar, Siberian crabapple.	Eastern white pine, green ash.	Imperial Carolina poplar.
35---------- Palms	Silky dogwood, common ninebark, nannyberry viburnum, American cranberrybush.	Northern whitecedar, Black Hills spruce, Manchurian crabapple, white spruce.	Eastern white pine, Norway spruce, green ash.	Imperial Carolina poplar.
37A---------- Matherton	Nannyberry viburnum, American cranberrybush.	Northern whitecedar, white spruce, Manchurian crabapple, Amur maple.	Eastern white pine, Norway spruce.	Imperial Carolina poplar.
38---------- Edwards	Amur privet, nannyberry viburnum, American cranberrybush, silky dogwood, common ninebark, lilac, Amur maple.	White spruce, Siberian crabapple, northern whitecedar.	Green ash----------	Imperial Carolina poplar.
39---------- Gilford	Silky dogwood, American cranberrybush, Amur privet, lilac, nannyberry viburnum.	Northern whitecedar, white spruce, Manchurian crabapple.	Norway spruce, eastern white pine, green ash.	Imperial Carolina poplar.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--			
	8-15	16-25	26-35	>35
40A---------- Locke	Silky dogwood, American cranberrybush, nannyberry viburnum, lilac.	Northern whitecedar, white spruce, Manchurian crabapple.	Eastern white pine, Norway spruce, green ash.	Imperial Carolina poplar.
42B, 42C2, 42D2, 42E---------- Riddles	Silky dogwood, Siberian peashrub, lilac, Amur maple.	Northern whitecedar, Black Hills spruce, Siberian crabapple.	Green ash, Norway spruce, jack pine, red pine, eastern white pine.	---
43: Histosols.				
Aquents.				
44B, 44C2, 44D2--- Leoni	Siberian peashrub, Amur maple, lilac, Manchurian crabapple, nannyberry viburnum.	Red pine, Austrian pine, green ash, eastern redcedar.	Eastern white pine----	---
45. Napoleon				
46---------- Wallkill	Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet.	Washington hawthorn, blue spruce, white fir, northern whitecedar, Austrian pine, Norway spruce.	Eastern white pine----	Pin oak.
50B, 50C, 50E----- Coloma	Eastern redcedar, Siberian peashrub, lilac, American cranberrybush, silky dogwood, gray dogwood, Amur maple.	Norway spruce---------	Eastern white pine, red pine, jack pine.	---
51. Glendora				
55. Pits				
57---------- Shoals	Silky dogwood, lilac, Amur privet, Amur maple, American cranberrybush.	Northern whitecedar, white spruce.	Eastern white pine, Norway spruce, green ash, red maple.	Carolina poplar.
58B---------- Seward	Eastern redcedar, lilac, Amur maple, American cranberrybush, Siberian peashrub, silky dogwood, gray dogwood.	Norway spruce---------	Eastern white pine, red pine, jack pine.	---

TABLE 10.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
10B:				
Hillsdale	Slight	Slight	Moderate: slope, small stones.	Slight.
Riddles	Slight	Slight	Moderate: slope, small stones.	Slight.
10C2:				
Hillsdale	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Riddles	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
10D2:				
Hillsdale	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Riddles	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
10E:				
Hillsdale	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Riddles	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
11B---------- Eleva	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Moderate: large stones.
11C---------- Eleva	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Moderate: large stones.
11D---------- Eleva	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: large stones, slope.
12B:				
Williamstown	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Moderate: wetness.
Conover	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.
12C2---------- Miami	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.
12D2---------- Miami	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
12E--- Miami	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
13B--- Conover	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.
14--- Wolcott	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
15B--- Boyer	Slight---	Slight---	Moderate: slope, small stones.	Slight.
15C--- Boyer	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
15D2, 15E--- Boyer	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.
16B--- Fox	Slight---	Slight---	Moderate: slope.	Slight.
16C2--- Fox	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
16D2, 16E--- Fox	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.
17--- Sebewa	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
18B: Glynwood---	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Moderate: wetness.
Blount---	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.
18C2--- Morley	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.
18D2--- Morley	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
18E--- Morley	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
19B--- Blount	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.
20--- Pewamo	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
24B---------- Spinks	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.
24C---------- Spinks	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.
24D---------- Spinks	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, too sandy.
25B---------- Thetford	Severe: wetness.	Moderate: wetness, too sandy.	Severe: wetness.	Moderate: wetness, too sandy.
29B---------- Steamburg	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones, percs slowly.	Slight.
29C---------- Steamburg	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight.
29D---------- Steamburg	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
32---------- Sloan	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.
33---------- Houghton	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
34---------- Adrian	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
35---------- Palms	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
37A---------- Matherton	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
38---------- Edwards	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
39---------- Gilford	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
40A---------- Locke	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
42B---------- Riddles	Slight----------	Slight----------	Moderate: slope, small stones.	Slight.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
42C2--- Riddles	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
42D2--- Riddles	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
42E--- Riddles	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
43: Histosols. Aquents.				
44B--- Leoni	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight.
44C2--- Leoni	Severe: small stones.	Severe: small stones.	Severe: slope, small stones.	Severe: small stones.
44D2--- Leoni	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: small stones.
45--- Napoleon	Severe: ponding, excess humus, too acid.	Severe: ponding, excess humus, too acid.	Severe: excess humus, ponding, too acid.	Severe: ponding, excess humus.
46--- Wallkill	Severe: flooding, wetness, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness.	Severe: wetness, excess humus.
50B--- Coloma	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
50C--- Coloma	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
50E--- Coloma	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.
51--- Glendora	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.
55. Pits				
57--- Shoals	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
58B--- Seward	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Moderate: too sandy.

TABLE 11.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
10B:										
Hillsdale	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Riddles	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
10C2:										
Hillsdale	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Riddles	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
10D2:										
Hillsdale	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Riddles	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
10E:										
Hillsdale	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Riddles	Very poor.	Poor	Fair	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
11B, 11C---- Eleva	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
11D---- Eleva	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
12B:										
Williamstown	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Conover	Good	Good	Good	Good	Fair	Poor	Poor	Good	Good	Poor.
12C2---- Miami	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
12D2---- Miami	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
12E---- Miami	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
13B---- Conover	Good	Good	Good	Good	Fair	Poor	Poor	Good	Good	Poor.
14---- Wolcott	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
15B, 15C---------- Boyer	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
15D2, 15E---------- Boyer	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	---	---	---
16B---------- Fox	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
16C2---------- Fox	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
16D2---------- Fox	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
16E---------- Fox	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
17---------- Sebewa	Poor	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.
18B:										
Glynwood----------	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Blount----------	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
18C2---------- Morley	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
18D2, 18E---------- Morley	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
19B---------- Blount	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
20---------- Pewamo	Poor	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.
24B---------- Spinks	Fair	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
24C, 24D---------- Spinks	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
25B---------- Thetford	Fair	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
29B---------- Steamburg	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
29C---------- Steamburg	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
29D---------- Steamburg	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
32---------- Sloan	Fair	Fair	Good	Poor	Poor	Good	Good	Fair	Poor	Good.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
33--Houghton	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
34--Adrian	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
35--Palms	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
37A--Matherton	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
38--Edwards	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
39--Gilford	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
40A--Locke	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair.
42B--Riddles	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
42C2--Riddles	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
42D2--Riddles	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
42E--Riddles	Very poor.	Poor	Fair	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
43: Histosols. Aquents.										
44B--Leoni	Poor	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
44C2--Leoni	Poor	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
44D2--Leoni	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
45--Napoleon	Very poor.	Very poor.	Poor	Poor	Poor	Good	Good	Very poor.	Poor	Good.
46--Wallkill	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
50B--Coloma	Fair	Fair	Fair	Fair	Good	Very poor.	Very poor.	Fair	Fair	Very poor.
50C--Coloma	Poor	Fair	Fair	Fair	Good	Very poor.	Very poor.	Fair	Fair	Very poor.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
50E---------- Coloma	Very poor.	Fair	Fair	Fair	Good	Very poor.	Very poor.	Fair	Fair	Very poor.
51---------- Glendora	Very poor.	Very poor.	Fair	Fair	Fair	Good	Good	Very poor.	Fair	Good.
55. Pits										
57---------- Shoals	Poor	Fair	Fair	Good	Good	Fair	Fair	Fair	Good	Fair.
58B---------- Seward	Poor	Fair	Good	Fair	Fair	Poor	Poor	Fair	Fair	Poor.

TABLE 12.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
10B:						
Hillsdale	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
Riddles	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.	Slight.
10C2:						
Hillsdale	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
Riddles	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, low strength, slope.	Moderate: slope.
10D2, 10E:						
Hillsdale	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Riddles	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
11B---------- Eleva	Severe: cutbanks cave.	Moderate: large stones.	Moderate: depth to rock, large stones.	Moderate: slope, large stones.	Moderate: frost action, large stones.	Severe: large stones.
11C---------- Eleva	Severe: cutbanks cave.	Moderate: slope, large stones.	Moderate: depth to rock, slope, large stones.	Severe: slope.	Moderate: slope, frost action, large stones.	Severe: large stones.
11D---------- Eleva	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: large stones, slope.
12B:						
Williamstown	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Moderate: wetness.
Conover	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
12C2---------- Miami	Moderate: slope, dense layer.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
12D2, 12E--------- Miami	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, low strength.	Severe: slope.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
13B---------- Conover	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
14---------- Wolcott	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
15B---------- Boyer	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Moderate: droughty.
15C---------- Boyer	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: droughty, slope.
15D2, 15E--------- Boyer	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
16B---------- Fox	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight---------	Moderate: shrink-swell.	Moderate: frost action, shrink-swell.	Slight.
16C2---------- Fox	Severe: cutbanks cave.	Moderate: shrink-swell, slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action, shrink-swell.	Moderate: slope.
16D2, 16E--------- Fox	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
17---------- Sebewa	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
18B: Glynwood---------	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell, slope.	Severe: low strength, frost action.	Slight.
Blount----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
18C2---------- Morley	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
18D2, 18E--------- Morley	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
19B---------- Blount	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
20---- Pewamo	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
24B---- Spinks	Severe: cutbanks cave.	Slight----	Slight----	Slight----	Slight----	Moderate: droughty.
24C---- Spinks	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
24D---- Spinks	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
25B---- Thetford	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
29B---- Steamburg	Severe: cutbanks cave.	Slight----	Slight----	Moderate: slope.	Moderate: frost action.	Slight.
29C---- Steamburg	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
29D---- Steamburg	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
32---- Sloan	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness, flooding.
33---- Houghton	Severe: ponding, excess humus.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: excess humus, ponding.
34---- Adrian	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
35---- Palms	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: ponding, frost action, subsides.	Severe: ponding, excess humus.
37A---- Matherton	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
38---- Edwards	Severe: ponding, excess humus.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: excess humus, ponding.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
39---------- Gilford	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
40A---------- Locke	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: large stones, wetness.
42B---------- Riddles	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.	Slight.
42C2---------- Riddles	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, low strength, slope.	Moderate: slope.
42D2, 42E--------- Riddles	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
43: Histosols. Aquents.						
44B---------- Leoni	Severe: cutbanks cave.	Moderate: large stones.	Moderate: large stones.	Moderate: large stones.	Moderate: frost action, large stones.	Moderate: small stones, large stones.
44C2---------- Leoni	Severe: cutbanks cave.	Moderate: slope, large stones.	Moderate: slope, large stones.	Severe: slope.	Moderate: slope, frost action, large stones.	Severe: small stones.
44D2---------- Leoni	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: small stones, slope.
45---------- Napoleon	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: too acid, ponding, excess humus.
46---------- Wallkill	Severe: excess humus, wetness.	Severe: flooding, wetness, low strength.	Severe: flooding, wetness, low strength.	Severe: flooding, wetness, low strength.	Severe: wetness, flooding, frost action.	Severe: wetness, flooding.
50B---------- Coloma	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Severe: droughty.
50C---------- Coloma	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
50E---------- Coloma	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
51---------- Glendora	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: wetness, flooding.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
55. Pits						
57---------- Shoals	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding, frost action.	Severe: wetness.
58B---------- Seward	Severe: cutbanks cave.	Slight---------	Severe: shrink-swell.	Slight---------	Moderate: frost action.	Moderate: droughty.

TABLE 13.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
10B:					
Hillsdale	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy, small stones.
Riddles	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Fair: small stones.
10C2:					
Hillsdale	Moderate: percs slowly, slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: too sandy, small stones, slope.
Riddles	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: small stones, slope.
10D2, 10E:					
Hillsdale	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope.
Riddles	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
11B	Severe: depth to rock, poor filter.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: depth to rock, large stones.
11C	Severe: depth to rock, poor filter.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: depth to rock, large stones.
11D	Severe: depth to rock, poor filter, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: depth to rock, large stones, slope.
12B:					
Williamstown	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey, wetness.
Conover	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
12C2	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
12D2, 12E---------- Miami	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
13B---------- Conover	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
14---------- Wolcott	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
15B---------- Boyer	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
15C---------- Boyer	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
15D2, 15E---------- Boyer	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
16B---------- Fox	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
16C2---------- Fox	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
16D2, 16E---------- Fox	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
17---------- Sebewa	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, small stones.
18B: Glynwood----------	Severe: wetness, percs slowly.	Moderate: slope.	Moderate: wetness, too clayey.	Moderate: wetness.	Fair: too clayey, wetness.
Blount----------	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
18C2---------- Morley	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
18D2, 18E---------- Morley	Severe: percs slowly, slope.	Severe: slope.	Severe: slope, too clayey.	Severe: slope.	Poor: slope, too clayey, hard to pack.
19B---------- Blount	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
20---------- Pewamo	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
24B---------- Spinks	Moderate: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
24C---------- Spinks	Moderate: slope, poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
24D---------- Spinks	Severe: slope, poor filter.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
25B---------- Thetford	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: too sandy, wetness.
29B---------- Steamburg	Severe: percs slowly.	Severe: seepage.	Moderate: too sandy.	Severe: seepage.	Fair: too sandy, small stones.
29C---------- Steamburg	Severe: percs slowly.	Severe: seepage, slope.	Moderate: slope, too sandy.	Severe: seepage.	Fair: too sandy, small stones, slope.
29D---------- Steamburg	Severe: percs slowly, slope.	Severe: seepage, slope.	Severe: slope.	Severe: seepage, slope.	Poor: slope.
32---------- Sloan	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
33---------- Houghton	Severe: subsides, ponding, percs slowly.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding, excess humus.	Severe: ponding, seepage.	Poor: ponding, excess humus.
34---------- Adrian	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
35---------- Palms	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: ponding, seepage.	Poor: ponding.
37A---------- Matherton	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
38---------- Edwards	Severe: subsides, ponding, percs slowly.	Severe: ponding, seepage, excess humus.	Severe: ponding.	Severe: ponding, seepage.	Poor: ponding, excess humus.
39---------- Gilford	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, small stones.
40A---------- Locke	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
42B---------- Riddles	Moderate: percs slowly.	Moderate: seepage, slope.	Slight----------	Slight----------	Fair: small stones.
42C2---------- Riddles	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: small stones, slope.
42D2, 42E---------- Riddles	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
43: Histosols. Aquents.					
44B---------- Leoni	Moderate: large stones.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
44C2---------- Leoni	Moderate: slope, large stones.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
44D2---------- Leoni	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
45---------- Napoleon	Severe: subsides, ponding.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus, too acid.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
46---------- Wallkill	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, excess humus.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: wetness, excess humus.
50B---------- Coloma	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
50C---------- Coloma	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
50E---------- Coloma	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
51---------- Glendora	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, wetness.
55. Pits					
57---------- Shoals	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
58B---------- Seward	Severe: wetness, percs slowly, poor filter.	Severe: seepage.	Severe: too clayey.	Severe: seepage.	Poor: too clayey, hard to pack.

TABLE 14.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
10B, 10C2: Hillsdale	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Riddles	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
10D2: Hillsdale	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
Riddles	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
10E: Hillsdale	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
Riddles	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
11B, 11C Eleva	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
11D Eleva	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
12B: Williamstown	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, too clayey.
Conover	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, too clayey, small stones.
12C2 Miami	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, slope, too clayey.
12D2 Miami	Fair: slope, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
12E Miami	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
13B---------- Conover	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, too clayey, small stones.
14---------- Wolcott	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
15B, 15C---------- Boyer	Good----------	Probable----------	Probable----------	Poor: small stones, area reclaim.
15D2, 15E---------- Boyer	Fair: slope.	Probable----------	Probable----------	Poor: small stones, area reclaim, slope.
16B, 16C2---------- Fox	Good----------	Probable----------	Probable----------	Poor: small stones, area reclaim.
16D2, 16E---------- Fox	Fair: slope.	Probable----------	Probable----------	Poor: small stones, area reclaim, slope.
17---------- Sebewa	Poor: wetness.	Probable----------	Probable----------	Poor: small stones, area reclaim, wetness.
18B:				
Glynwood----------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Blount----------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
18C2---------- Morley	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
18D2---------- Morley	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
18E---------- Morley	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
19B---------- Blount	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
20---------- Pewamo	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones, wetness.
24B---------- Spinks	Good----------	Probable----------	Improbable: too sandy.	Fair: too sandy.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
24C---------- Spinks	Good----------	Probable----------	Improbable: too sandy.	Fair: slope, too sandy.
24D---------- Spinks	Fair: slope.	Probable----------	Improbable: too sandy.	Poor: slope.
25B---------- Thetford	Fair: wetness.	Probable----------	Improbable: too sandy.	Poor: too sandy.
29B, 29C---------- Steamburg	Fair: thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
29D---------- Steamburg	Fair: thin layer, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
32---------- Sloan	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
33---------- Houghton	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: wetness, excess humus.
34---------- Adrian	Poor: wetness.	Probable----------	Improbable: too sandy.	Poor: excess humus, wetness.
35---------- Palms	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, excess humus.
37A---------- Matherton	Fair: wetness.	Probable----------	Probable----------	Poor: small stones, area reclaim.
38---------- Edwards	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: wetness, excess humus.
39---------- Gilford	Poor: wetness.	Probable----------	Probable----------	Poor: wetness, area reclaim.
40A---------- Locke	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
42B, 42C2---------- Riddles	Good----------	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
42D2---------- Riddles	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
42E---------- Riddles	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
43: Histosols. Aquents.				

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
44B, 44C2---------- Leoni	Fair: large stones.	Probable----------	Probable----------	Poor: small stones, area reclaim.
44D2---------- Leoni	Fair: large stones, slope.	Probable----------	Probable----------	Poor: small stones, area reclaim, slope.
45---------- Napoleon	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness, too acid.
46---------- Wallkill	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
50B, 50C---------- Coloma	Good----------	Probable----------	Improbable: too sandy.	Poor: too sandy, small stones.
50E---------- Coloma	Poor: slope.	Probable----------	Improbable: too sandy.	Poor: too sandy, small stones, slope.
51---------- Glendora	Poor: wetness.	Probable----------	Improbable: too sandy.	Poor: too sandy, wetness.
55. Pits				
57---------- Shoals	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
58B---------- Seward	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.

TABLE 15.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Grassed waterways
10B:						
Hillsdale	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, rooting depth.	Rooting depth.
Riddles	Moderate: seepage, slope.	Moderate: thin layer, piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Favorable.
10C2, 10D2, 10E:						
Hillsdale	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, rooting depth.	Slope, rooting depth.
Riddles	Severe: slope.	Moderate: thin layer, piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Slope.
11B---- Eleva	Severe: seepage.	Severe: piping, large stones.	Severe: no water.	Deep to water	Slope, large stones, depth to rock.	Large stones, depth to rock.
11C, 11D---- Eleva	Severe: seepage, slope.	Severe: piping, large stones.	Severe: no water.	Deep to water	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
12B:						
Williamstown	Moderate: seepage, slope.	Severe: thin layer.	Severe: no water.	Frost action, slope.	Slope, wetness, rooting depth.	Erodes easily, rooting depth.
Conover	Moderate: slope.	Severe: piping, wetness.	Severe: slow refill.	Frost action, slope.	Slope, wetness.	Wetness, erodes easily, rooting depth.
12C2, 12D2, 12E--- Miami	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, rooting depth.	Slope, erodes easily, rooting depth.
13B---- Conover	Slight----	Severe: piping, wetness.	Severe: slow refill.	Frost action---	Wetness----	Wetness, erodes easily, rooting depth.
14---- Wolcott	Moderate: seepage.	Severe: ponding.	Moderate: slow refill.	Ponding, frost action.	Ponding----	Wetness, erodes easily.
15B---- Boyer	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
15C, 15D2, 15E---- Boyer	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Grassed waterways
16B---------- Fox	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Soil blowing, slope.	Favorable.
16C2---------- Fox	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Soil blowing, slope.	Slope.
16D2, 16E---------- Fox	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope----------	Slope.
17---------- Sebewa	Severe: seepage.	Severe: seepage, ponding.	Severe: cutbanks cave.	Ponding, frost action, cutbanks cave.	Ponding, rooting depth.	Wetness, rooting depth.
18B:						
Glynwood---------	Moderate: slope.	Moderate: piping, wetness.	Severe: no water.	Percs slowly, frost action, slope.	Slope, wetness.	Erodes easily, rooting depth.
Blount----------	Moderate: slope.	Moderate: piping, wetness.	Severe: no water.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Wetness, erodes easily, rooting depth.
18C2, 18D2, 18E--- Morley	Severe: slope.	Moderate: hard to pack.	Severe: no water.	Deep to water	Slope, percs slowly.	Slope, erodes easily, percs slowly.
19B---------- Blount	Moderate: slope.	Moderate: piping, wetness.	Severe: no water.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Wetness, erodes easily, rooting depth.
20---------- Pewamo	Slight---------	Severe: ponding.	Severe: slow refill.	Ponding, frost action.	Ponding--------	Wetness.
24B---------- Spinks	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
24C, 24D---------- Spinks	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
25B---------- Thetford	Severe: seepage.	Severe: piping, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty.	Wetness, droughty.
29B---------- Steamburg	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Erodes easily.
29C, 29D---------- Steamburg	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Slope, erodes easily.
32---------- Sloan	Moderate: seepage.	Severe: piping, wetness.	Severe: slow refill.	Flooding, frost action.	Wetness, flooding.	Wetness, erodes easily.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Grassed waterways
33---------- Houghton	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Frost action, subsides, ponding.	Ponding, soil blowing.	Wetness.
34---------- Adrian	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, subsides, frost action.	Ponding, soil blowing, rooting depth.	Wetness, rooting depth.
35---------- Palms	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding--------	Wetness, erodes easily, rooting depth.
37A---------- Matherton	Severe: seepage.	Severe: seepage, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness--------	Wetness.
38---------- Edwards	Severe: seepage.	Severe: ponding, excess humus.	Severe: slow refill.	Frost action, ponding, subsides.	Ponding, soil blowing.	Wetness.
39---------- Gilford	Severe: seepage.	Severe: seepage, ponding.	Severe: cutbanks cave.	Ponding, frost action, cutbanks cave.	Ponding, soil blowing.	Wetness.
40A---------- Locke	Moderate: seepage.	Severe: piping, wetness.	Moderate: slow refill.	Frost action---	Wetness, soil blowing.	Wetness, rooting depth.
42B---------- Riddles	Moderate: seepage, slope.	Moderate: thin layer, piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Favorable.
42C2, 42D2, 42E--- Riddles	Severe: slope.	Moderate: thin layer, piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Slope.
43: Histosols. Aquents.						
44B---------- Leoni	Severe: seepage.	Severe: seepage, large stones.	Severe: no water.	Deep to water	Slope, large stones, droughty.	Large stones, droughty.
44C2, 44D2-------- Leoni	Severe: seepage, slope.	Severe: seepage, large stones.	Severe: no water.	Deep to water	Slope, large stones, droughty.	Large stones, slope, droughty.
45---------- Napoleon	Severe: seepage.	Severe: excess humus, ponding.	Moderate: slow refill.	Ponding, subsides, frost action.	Ponding, soil blowing, too acid.	Wetness.
46---------- Wallkill	Severe: seepage.	Severe: excess humus, wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness, erodes easily, flooding.	Wetness, erodes easily.
50B---------- Coloma	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Grassed waterways
50C, 50E---------- Coloma	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
51---------- Glendora	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Flooding, cutbanks cave.	Wetness, droughty, fast intake.	Wetness, droughty.
55. Pits						
57---------- Shoals	Moderate: seepage.	Severe: piping, wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness, erodes easily, flooding.	Wetness, erodes easily.
58B---------- Seward	Severe: seepage.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly---	Wetness, droughty.	Droughty, rooting depth.

TABLE 16.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
10B:											
Hillsdale-------	0-9	Sandy loam-------	SM, SC, ML, CL	A-2-4, A-4, A-1-b	0-5	90-100	75-100	45-85	20-55	<25	2-10
	9-28	Sandy loam, sandy clay loam, loam.	SC-SM, SC, CL-ML, CL	A-2-4, A-4	0-5	90-100	75-100	55-85	30-70	20-30	4-10
	28-43	Sandy loam-------	SM, SC-SM, SC, SP-SM	A-2-4, A-1-b	0-5	90-100	75-100	45-85	20-50	<25	2-10
	43-60	Sandy loam, fine sandy loam.	SM, SC-SM, SC, SP-SM	A-2-4, A-4, A-1-b	0-5	90-100	75-100	40-75	10-50	<25	2-10
Riddles---------	0-10	Sandy loam-------	SM, SC-SM	A-4	0-3	90-100	75-95	45-85	35-50	<25	NP-7
	10-31	Sandy clay loam, loam, sandy loam.	CL, SC	A-6	0-3	90-100	75-95	45-90	45-90	25-40	10-20
	31-40	Loam, sandy clay loam.	CL-ML, CL, SC-SM, SC	A-4, A-6	0-3	90-100	75-95	45-90	45-90	25-35	5-15
	40-60	Sandy loam, loam	SM, SC-SM, CL-ML, ML	A-4	0-3	85-95	75-90	45-90	40-90	<20	NP-7
10C2:											
Hillsdale-------	0-7	Sandy loam-------	SM, SC, ML, CL	A-2-4, A-4, A-1-b	0-5	90-100	75-100	45-85	20-55	<25	2-10
	7-15	Sandy loam, sandy clay loam, loam.	SC-SM, SC, CL-ML, CL	A-2-4, A-4	0-5	90-100	75-100	55-85	30-70	20-30	4-10
	15-43	Sandy loam-------	SM, SC-SM, SC, SP-SM	A-2-4, A-1-b	0-5	90-100	75-100	45-85	20-50	<25	2-10
	43-60	Sandy loam, fine sandy loam.	SM, SC-SM, SC, SP-SM	A-2-4, A-4, A-1-b	0-5	90-100	75-100	40-75	10-50	<25	2-10
Riddles---------	0-8	Sandy loam-------	SM, SC-SM	A-4	0-3	90-100	75-95	45-85	35-50	<25	NP-7
	8-31	Sandy clay loam, loam, sandy loam.	CL, SC	A-6	0-3	90-100	75-95	45-90	45-90	25-40	10-20
	31-40	Loam, sandy clay loam.	CL-ML, CL, SC-SM, SC	A-4, A-6	0-3	90-100	75-95	45-90	45-90	25-35	5-15
	40-60	Sandy loam, loam	SM, SC-SM, CL-ML, ML	A-4	0-3	85-95	75-90	45-90	40-90	<20	NP-7
10D2:											
Hillsdale-------	0-7	Sandy loam-------	SM, SC, ML, CL	A-2-4, A-4, A-1-b	0-5	90-100	75-100	45-85	20-55	<25	2-10
	7-15	Sandy loam, sandy clay loam, loam.	SC-SM, SC, CL-ML, CL	A-2-4, A-4	0-5	90-100	75-100	55-85	30-70	20-30	4-10
	15-43	Sandy loam-------	SM, SC-SM, SC, SP-SM	A-2-4, A-1-b	0-5	90-100	75-100	45-85	20-50	<25	2-10
	43-60	Sandy loam, fine sandy loam.	SM, SC-SM, SC, SP-SM	A-2-4, A-4, A-1-b	0-5	90-100	75-100	40-75	10-50	<25	2-10

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
10D2:											
Riddles	0-8	Sandy loam	SM, SC-SM	A-4	0-3	90-100	75-95	45-85	35-50	<25	NP-7
	8-31	Sandy clay loam, loam, sandy loam.	CL, SC	A-6	0-3	90-100	75-95	45-90	45-90	25-40	10-20
	31-40	Loam, sandy clay loam.	CL-ML, CL, SC-SM, SC	A-4, A-6	0-3	90-100	75-95	45-90	45-90	25-35	5-15
	40-60	Sandy loam, loam	SM, SC-SM, CL-ML, ML	A-4	0-3	85-95	75-90	45-90	40-90	<20	NP-7
10E:											
Hillsdale	0-9	Sandy loam	SM, SC, ML, CL	A-2-4, A-4, A-1-b	0-5	90-100	75-100	45-85	20-55	<25	2-10
	9-28	Sandy loam, sandy clay loam, loam.	SC-SM, SC, CL-ML, CL	A-2-4, A-4	0-5	90-100	75-100	55-85	30-70	20-30	4-10
	28-43	Sandy loam	SM, SC-SM, SC, SP-SM	A-2-4, A-1-b	0-5	90-100	75-100	45-85	20-50	<25	2-10
	43-60	Sandy loam, fine sandy loam.	SM, SC-SM, SC, SP-SM	A-2-4, A-4, A-1-b	0-5	90-100	75-100	40-75	10-50	<25	2-10
Riddles	0-10	Sandy loam	SM, SC-SM	A-4	0-3	90-100	75-95	45-85	35-50	<25	NP-7
	10-31	Sandy clay loam, loam, sandy loam.	CL, SC	A-6	0-3	90-100	75-95	45-90	45-90	25-40	10-20
	31-40	Loam, sandy clay loam.	CL-ML, CL, SC-SM, SC	A-4, A-6	0-3	90-100	75-95	45-90	45-90	25-35	5-15
	40-60	Sandy loam, loam	SM, SC-SM, CL-ML, ML	A-4	0-3	85-95	75-90	45-90	40-90	<20	NP-7
11B, 11C, 11D---- Eleva	0-6	Channery fine sandy loam.	ML, CL, SM, SC	A-4, A-6, A-2	5-40	70-100	60-90	60-90	20-80	20-30	3-12
	6-11	Sandy loam, fine sandy loam, channery fine sandy loam.	ML, CL, SM, SC	A-4, A-6, A-2	5-40	70-100	60-90	60-90	20-80	20-30	3-12
	11-18	Sandy loam, channery fine sandy loam, fine sandy loam.	SM, SC-SM	A-2, A-4	5-40	70-100	60-90	60-90	20-50	<25	2-6
	18-37	Channery loamy fine sand, channery fine sand, very channery loamy fine sand.	SM, SP-SM	A-2-4, A-3	5-40	70-100	50-80	50-80	5-30	<20	NP-2
	37	Weathered bedrock	---	---	---	---	---	---	---	---	---
12B:											
Williamstown	0-10	Loam	CL, CL-ML	A-4, A-6	0	100	100	85-100	60-90	20-35	4-15
	10-33	Clay loam, loam	CL	A-6, A-4	0	100	85-95	80-95	60-80	25-45	9-25
	33-60	Loam	ML, CL-ML, CL	A-4, A-6	0-2	100	95-100	80-95	55-75	20-35	3-11
Conover	0-9	Loam	ML, CL, CL-ML	A-4	0-5	95-100	90-100	75-95	55-75	20-30	3-10
	9-27	Clay loam, silty clay loam, loam.	CL	A-6	0-5	95-100	90-100	80-95	50-90	29-40	15-25
	27-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	50-75	25-34	6-14

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
12C2---------- Miami	0-6	Loam----------	CL, CL-ML, ML	A-4	0	100	95-100	80-100	50-90	15-30	3-10
	6-24	Clay loam--------	CL, SC	A-6	0	90-100	85-100	70-95	40-95	30-40	15-25
	24-60	Loam----------	CL, CL-ML, SC, SC-SM	A-4, A-6	0-3	85-100	85-100	70-90	45-70	20-40	5-20
12D2---------- Miami	0-6	Clay loam--------	CL	A-6	0	100	90-100	75-95	65-95	30-40	15-20
	6-24	Clay loam--------	CL, SC	A-6	0	90-100	85-100	70-95	40-95	30-40	15-25
	24-60	Loam----------	CL, CL-ML, SC, SC-SM	A-4, A-6	0-3	85-100	85-100	70-90	45-70	20-40	5-20
12E---------- Miami	0-6	Loam----------	CL, CL-ML, ML	A-4	0	100	95-100	80-100	50-90	15-30	3-10
	6-24	Clay loam--------	CL, SC	A-6	0	90-100	85-100	70-95	40-95	30-40	15-25
	24-60	Loam----------	CL, CL-ML, SC, SC-SM	A-4, A-6	0-3	85-100	85-100	70-90	45-70	20-40	5-20
13B---------- Conover	0-9	Loam----------	ML, CL, CL-ML	A-4	0-5	95-100	90-100	75-95	55-75	20-30	3-10
	9-27	Clay loam, silty clay loam, loam.	CL	A-6	0-5	95-100	90-100	80-95	50-90	29-40	15-25
	27-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	50-75	25-34	6-14
14---------- Wolcott	0-20	Silt loam--------	CL	A-4, A-6	0	100	90-100	85-100	65-90	20-30	8-14
	20-32	Clay loam, loam	CL	A-6, A-7	0	90-100	85-100	85-100	60-90	35-50	18-30
	32-60	Loam----------	CL, CL-ML	A-4	0	90-100	80-95	80-95	55-95	20-30	4-10
15B, 15C--------- Boyer	0-11	Loamy sand-------	SM, SP-SM	A-2, A-1	0-5	95-100	75-95	30-80	10-35	<20	NP-4
	11-16	Loamy sand, gravelly loamy sand, fine sandy loam.	SM, ML	A-2, A-4, A-1-b	0-5	85-100	60-95	30-85	10-55	<20	NP-4
	16-23	Sandy loam, loam, gravelly sandy loam.	SC, SC-SM, CL, CL-ML	A-2, A-4, A-1-b	0-5	80-100	60-95	35-90	15-75	20-30	5-10
	23-60	Very gravelly coarse sand, coarse sand, loamy sand.	SP, SP-SM, GP, GP-GM	A-1, A-2, A-3	0-10	40-95	30-85	20-60	0-10	---	NP
15D2---------- Boyer	0-5	Gravelly loamy sand.	SM, SP-SM	A-2, A-1, A-3	0-5	65-85	55-75	30-60	5-25	<20	NP-4
	5-10	Loamy sand, gravelly loamy sand, fine sandy loam.	SM, SP-SM	A-2, A-4, A-1-b	0-5	85-100	60-95	30-85	10-50	<20	NP-4
	10-24	Sandy loam, loam, gravelly sandy loam.	SC, SC-SM, CL, CL-ML	A-2, A-4, A-1-b	0-5	80-100	60-95	35-90	15-75	20-30	5-10
	24-60	Very gravelly coarse sand, coarse sand, loamy sand.	SP, SP-SM, GP, GP-GM	A-1, A-2, A-3	0-10	40-95	30-85	20-60	0-10	---	NP

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
15E---------- Boyer	0-7	Gravelly loamy sand.	SM, SP-SM	A-2, A-1, A-3	0-5	65-85	55-75	30-60	5-25	<20	NP-4
	7-16	Loamy sand, gravelly loamy sand, fine sandy loam.	SM, SP-SM	A-2, A-4, A-1-b	0-5	85-100	60-95	30-85	10-50	<20	NP-4
	16-23	Sandy loam, loam, gravelly sandy loam.	SC, SC-SM, CL, CL-ML	A-2, A-4, A-1-b	0-5	80-100	60-95	35-90	15-75	20-30	5-10
	23-60	Very gravelly coarse sand, coarse sand, loamy sand.	SP, SP-SM, GP, GP-GM	A-1, A-2, A-3	0-10	40-95	30-85	20-60	0-10	---	NP
16B, 16C2-------- Fox	0-8	Sandy loam-------	SM, SC-SM	A-4, A-2	0	95-100	95-100	55-80	20-50	<25	2-7
	8-34	Gravelly sandy loam, sandy clay loam, gravelly sandy clay loam.	CL, SC, GC	A-2, A-6, A-7	0-5	55-100	55-100	30-95	15-80	22-45	10-25
	34-60	Sand and gravel, sand, coarse sand.	SP, GP, SP-SM, GP-GM	A-1, A-2, A-3	0-10	30-100	30-100	10-95	2-10	---	NP
16D2, 16E-------- Fox	0-8	Gravelly sandy clay loam.	SC, CL	A-2, A-6	0-3	75-85	65-75	55-75	25-75	25-40	10-20
	8-34	Gravelly sandy loam, gravelly sandy clay loam, sandy clay loam.	CL, SC	A-2, A-6, A-7	0-5	55-100	55-100	30-95	15-80	25-45	10-25
	34-60	Sand and gravel, sand, coarse sand.	SP, SM, GP, GM	A-1, A-2, A-3	0-10	30-100	30-100	15-95	2-20	---	NP
17---------- Sebewa	0-11	Loam----------	CL, CL-ML	A-4, A-6	0	95-100	75-100	65-95	50-75	20-35	4-15
	11-23	Clay loam, loam, gravelly clay loam.	SC, CL	A-6, A-7, A-2	0	95-100	60-90	50-90	25-75	25-45	10-25
	23-60	Gravelly coarse sand, loamy sand, sand.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2	0-5	40-75	25-75	20-55	0-10	---	NP
18B:											
Glynwood--------	0-7	Clay loam--------	CL	A-6, A-7	0-2	95-100	85-100	75-100	60-95	25-45	10-22
	7-26	Clay, clay loam, silty clay loam.	CL, CH	A-7, A-6	0-5	95-100	85-100	75-100	65-95	35-55	15-30
	26-60	Clay loam--------	CL	A-6, A-4	0-5	95-100	85-100	75-100	60-95	25-45	10-22
Blount----------	0-9	Silt loam--------	CL	A-6, A-4	0-5	95-100	95-100	90-100	80-95	25-40	8-20
	9-32	Silty clay loam, silty clay, clay loam.	CH, CL	A-7, A-6	0-5	95-100	90-100	80-90	75-85	35-60	15-35
	32-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	90-100	90-100	80-100	70-90	30-45	10-25
18C2---------- Morley	0-6	Loam----------	CL, CL-ML	A-6, A-4	0-5	95-100	95-100	90-100	75-95	25-40	5-15
	6-31	Silty clay loam, clay loam, silty clay.	CL	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-50	15-30
	31-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-50	15-30

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
18D2---------- Morley	0-6	Clay loam--------	CL	A-6, A-7	0-5	95-100	90-100	85-95	80-90	30-45	15-25
	6-31	Silty clay loam, clay loam, silty clay.	CL	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-50	15-30
	31-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-50	15-30
18E---------- Morley	0-6	Loam----------	CL, CL-ML	A-6, A-4	0-5	95-100	95-100	90-100	75-95	25-40	5-15
	6-31	Silty clay loam, clay loam, silty clay.	CL	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-50	15-30
	31-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-50	15-30
19B---------- Blount	0-9	Silt loam--------	CL	A-6, A-4	0-5	95-100	95-100	90-100	80-95	25-40	8-20
	9-32	Silty clay loam, silty clay, clay loam.	CH, CL	A-7, A-6	0-5	95-100	90-100	80-90	75-85	35-60	15-35
	32-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	90-100	90-100	80-100	70-90	30-45	10-25
20---------- Pewamo	0-11	Silt loam--------	CL	A-4, A-6	0-5	90-100	75-100	75-100	50-90	25-35	9-15
	11-48	Clay loam, silty clay.	CL, CH	A-7	0-5	90-100	75-100	75-100	75-95	40-60	20-35
	48-60	Clay loam, silty clay loam.	CL	A-7	0-5	90-100	75-100	75-100	70-95	40-50	15-25
24B, 24C, 24D---- Spinks	0-9	Loamy sand-------	SM, SC-SM, SP-SM	A-2-4, A-1-b	0	95-100	80-100	35-90	10-30	<25	NP-7
	9-60	Sand, loamy sand, sandy loam.	SM, SP-SM, SC-SM	A-2-4, A-1-b	0	95-100	90-100	60-80	20-50	<30	NP-10
25B---------- Thetford	0-10	Loamy sand-------	SM, SC-SM, SP-SM	A-2, A-4, A-1-b	0	95-100	90-100	45-80	10-45	<25	NP-7
	10-24	Sand, loamy sand	SM, SP-SM, SC-SM	A-2, A-3, A-1-b	0	95-100	90-100	45-80	5-35	<25	NP-7
	24-60	Loamy sand, sandy loam, sand.	SM, SC-SM, SC	A-2, A-4	0	95-100	90-100	60-80	20-50	<30	NP-10
29B, 29C, 29D---- Steamburg	0-9	Sandy loam-------	SM, SC-SM, SC	A-2, A-4	0-5	90-100	75-100	50-70	25-40	10-28	NP-9
	9-34	Sandy loam, loamy sand.	SM, SC-SM, SC, SP-SM	A-2, A-4, A-1-b	0-5	90-100	75-100	40-70	10-40	10-28	NP-9
	34-40	Loam, clay loam, silty clay loam.	CL	A-4, A-6, A-7-6	0-5	95-100	90-95	75-95	60-90	25-45	9-25
	40-60	Loam, clay loam	CL	A-4, A-6, A-7-6	0-5	90-100	85-95	80-95	60-80	25-45	9-25
32---------- Sloan	0-16	Silt loam--------	CL, ML, CL-ML	A-6, A-4	0	100	95-100	85-100	70-95	20-40	3-15
	16-31	Loam, silt loam	CL, ML	A-6, A-7, A-4	0	100	90-100	85-100	75-95	30-45	8-18
	31-60	Stratified fine sandy loam to silt loam.	ML, CL	A-4, A-6	0	95-100	90-100	60-95	50-90	25-40	3-15
33---------- Houghton	0-9	Muck----------	PT	A-8	0	---	---	---	---	---	---
	9-60	Muck----------	PT	A-8	0	---	---	---	---	---	---
34---------- Adrian	0-26	Muck----------	PT	A-8	---	---	---	---	---	---	---
	26-60	Sand, fine sand, coarse sand.	SP, SM	A-2, A-3, A-1	0	80-100	60-100	50-75	0-35	---	NP

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
35----------	0-13	Muck----------	PT	A-8	0	---	---	---	---	---	---
Palms	13-16	Muck----------	PT	A-8	0	---	---	---	---	---	---
	16-60	Silt loam, silty clay loam, sandy loam.	CL-ML, CL, SC, SC-SM	A-4, A-6, A-7, A-2	0	85-100	90-100	35-95	15-90	20-45	5-20
37A----------	0-9	Loam----------	CL, CL-ML	A-4, A-6	0-5	90-100	75-100	65-95	50-75	20-30	4-11
Matherton	9-25	Sandy clay loam, gravelly clay loam, loam, gravelly loam.	SC, CL	A-6, A-2, A-7	0-5	85-95	60-90	50-90	30-75	30-45	10-25
	25-60	Gravelly coarse sand, fine sand, very gravelly sand.	GP, SP, SM, GM	A-1, A-3, A-2-4	0-10	40-100	25-75	20-55	0-15	---	NP
38----------	0-18	Muck----------	PT	A-8	0	---	---	---	---	---	---
Edwards	18-60	Marl----------	---	---	0	100	95-100	80-90	60-80	---	---
39----------	0-16	Sandy loam-------	SC, SC-SM, SM	A-4, A-2-4	0	95-100	90-100	60-70	30-40	20-30	2-10
Gilford	16-36	Sandy loam-------	SM, SC, SC-SM	A-2-4	0	90-100	90-100	55-70	25-35	20-30	NP-8
	36-42	Coarse sand, sand, loamy sand.	SM, SP, SP-SM	A-3, A-1-b, A-2-4	0	90-100	85-100	18-60	3-18	---	NP
	42-60	Gravelly coarse sand, very gravelly coarse sand.	SP, SP-SM, GP, GP-GM	A-1	0-15	40-85	35-75	20-50	3-10	---	NP
40A----------	0-9	Fine sandy loam	SM, SC-SM, ML, CL-ML	A-2-4, A-4	0-7	95-100	75-95	60-90	25-60	<30	3-9
Locke	9-37	Sandy loam, loam	SC, CL	A-6	0-7	95-100	75-95	65-85	35-55	20-30	10-15
	37-60	Sandy loam, fine sandy loam.	SM, SC-SM, SC	A-2-4, A-4	0-7	95-100	75-95	60-85	30-50	<30	NP-10
42B----------	0-10	Sandy loam-------	SM, SC-SM	A-4	0-3	90-100	75-95	45-85	35-50	<25	NP-7
Riddles	10-31	Sandy clay loam, loam, sandy loam.	CL, SC	A-6	0-3	90-100	75-95	45-90	45-90	25-40	10-20
	31-40	Loam, sandy loam	CL-ML, CL, SC-SM, SC	A-4, A-6	0-3	90-100	75-95	45-90	45-90	25-35	5-15
	40-60	Sandy loam, loam	SM, SC-SM, CL-ML, ML	A-4	0-3	85-95	75-90	45-90	40-90	<20	NP-7
42C2, 42D2-------	0-8	Sandy loam-------	SM, SC-SM	A-4	0-3	90-100	75-95	45-85	35-50	<25	NP-7
Riddles	8-31	Sandy clay loam, loam, sandy loam.	CL, SC	A-6	0-3	90-100	75-95	45-90	45-90	25-40	10-20
	31-40	Loam, sandy loam	CL-ML, CL, SC-SM, SC	A-4, A-6	0-3	90-100	75-95	45-90	45-90	25-35	5-15
	40-60	Sandy loam, loam	SM, SC-SM, CL-ML, ML	A-4	0-3	85-95	75-90	45-90	40-90	<20	NP-7
42E----------	0-10	Sandy loam-------	SM, SC-SM	A-4	0-3	90-100	75-95	45-85	35-50	<25	NP-7
Riddles	10-31	Sandy clay loam, loam, sandy loam.	CL, SC	A-6	0-3	90-100	75-95	45-90	45-90	25-40	10-20
	31-40	Loam, sandy loam	CL-ML, CL, SC-SM, SC	A-4, A-6	0-3	90-100	75-95	45-90	45-90	25-35	5-15
	40-60	Sandy loam, loam	SM, SC-SM, CL-ML, ML	A-4	0-3	85-95	75-90	45-90	40-90	<20	NP-7

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
43: Histosols. Aquents.											
44B---------- Leoni	0-8	Gravelly sandy loam.	SM, SC, SC-SM	A-2, A-1	5-10	85-95	50-75	35-60	15-35	<30	NP-10
	8-34	Very gravelly clay loam, extremely gravelly sandy loam.	SC, GC	A-6, A-4, A-7	5-50	70-85	25-50	20-45	15-40	25-45	7-22
	34-60	Gravelly coarse sand, extremely gravelly coarse sand.	SM, SP-SM, SC	A-1, A-2, A-3	5-50	65-85	25-75	35-50	5-40	<30	NP-10
44C2, 44D2------- Leoni	0-8	Very gravelly sandy loam.	SM, SC, SC-SM	A-2, A-1	5-10	40-65	25-50	25-40	5-30	<30	NP-10
	8-30	Very gravelly clay loam, extremely gravelly sandy loam.	SC, GC	A-6, A-4, A-7	5-50	70-85	25-50	20-45	15-40	25-45	7-22
	30-60	Gravelly coarse sand, extremely gravelly coarse sand.	SM, SP-SM, SC	A-1, A-2, A-3	5-50	65-85	25-75	35-50	5-40	<30	NP-10
45---------- Napoleon	0-14	Muck----------	PT	A-8	0	---	---	---	---	---	---
	14-60	Mucky peat, peat	PT	A-8	0	---	---	---	---	---	---
46---------- Wallkill	0-6	Silt loam--------	CL	A-5, A-7	0	95-100	90-100	70-100	50-90	40-50	5-15
	6-34	Silt loam--------	CL	A-4, A-6	0	95-100	90-100	70-100	50-90	40-50	5-10
	34-60	Muck, mucky peat	PT	A-8	0	---	---	---	---	---	---
50B, 50C, 50E---- Coloma	0-9	Sand----------	SP, SM, SP-SM	A-2, A-3	0-7	75-100	75-100	50-70	2-15	---	NP
	9-35	Sand, loamy sand	SP, SM, SP-SM	A-2, A-3	0-7	75-100	75-100	50-75	2-30	---	NP
	35-60	Stratified sand to sandy loam.	SP, SM, SP-SM	A-2, A-3, A-4	0-7	75-100	75-100	50-100	2-40	---	NP
51---------- Glendora	0-16	Mucky loamy sand	SP-SM, SM, SC-SM	A-2, A-1	0-5	95-100	90-100	45-75	10-35	<25	NP-7
	16-60	Stratified sand to loamy fine sand.	SP, SM, SP-SM	A-3, A-2-4, A-1-b	0-5	95-100	90-100	45-85	0-35	---	NP
55. Pits											
57---------- Shoals	0-8	Loam----------	CL, CL-ML	A-4, A-6	0	100	100	90-100	65-90	20-35	6-15
	8-30	Silt loam, loam	CL, CL-ML	A-4, A-6	0	100	100	90-100	75-85	25-40	5-15
	30-60	Stratified silt loam to sandy loam.	ML, CL, CL-ML	A-4	0-3	90-100	85-100	60-80	50-70	<30	4-10

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
58B---------- Seward	0-8	Loamy sand-------	SM, ML	A-2, A-4, A-1	0	100	95-100	45-80	15-50	---	NP
	8-35	Loamy sand-------	SM, ML	A-2, A-4, A-1	0	100	95-100	45-80	15-50	---	NP
	35-40	Sandy loam-------	SM	A-4	0	100	90-100	60-80	35-50	<40	NP-10
	40-60	Clay loam, silty clay loam.	CH, CL	A-7	0	100	90-100	85-100	75-95	40-65	20-38

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
10B:											
Hillsdale-------	0-9	2-15	1.30-1.60	2.0-6.0	0.13-0.18	5.1-7.3	Low----------	0.24	5	3	1-3
	9-28	10-18	1.40-1.70	0.6-2.0	0.12-0.18	4.5-6.5	Low----------	0.24			
	28-43	5-15	1.60-1.75	0.6-6.0	0.12-0.14	5.1-6.5	Low----------	0.24			
	43-60	5-15	1.60-1.80	0.6-6.0	0.08-0.13	7.9-8.4	Low----------	0.24			
Riddles---------	0-10	4-14	1.35-1.45	2.0-6.0	0.13-0.18	5.6-7.3	Low----------	0.24	5	3	.5-2
	10-31	18-30	1.40-1.60	0.6-2.0	0.12-0.18	4.5-7.3	Moderate-----	0.32			
	31-40	15-30	1.40-1.60	0.6-2.0	0.16-0.19	6.6-7.8	Low----------	0.32			
	40-60	8-15	1.45-1.65	0.6-2.0	0.08-0.13	7.4-8.4	Low----------	0.32			
10C2:											
Hillsdale-------	0-7	2-15	1.30-1.60	2.0-6.0	0.13-0.18	5.1-7.3	Low----------	0.24	5	3	1-3
	7-15	10-18	1.40-1.70	0.6-2.0	0.12-0.18	4.5-6.5	Low----------	0.24			
	15-43	5-15	1.60-1.75	0.6-6.0	0.12-0.14	5.1-6.5	Low----------	0.24			
	43-60	5-15	1.60-1.80	0.6-6.0	0.08-0.13	7.9-8.4	Low----------	0.24			
Riddles---------	0-8	4-14	1.35-1.45	2.0-6.0	0.13-0.18	5.6-7.3	Low----------	0.24	5	3	.5-2
	8-31	18-30	1.40-1.60	0.6-2.0	0.12-0.18	4.5-7.3	Moderate-----	0.32			
	31-40	15-30	1.40-1.60	0.6-2.0	0.16-0.19	6.6-7.8	Low----------	0.32			
	40-60	8-15	1.45-1.65	0.6-2.0	0.08-0.13	7.4-8.4	Low----------	0.32			
10D2:											
Hillsdale-------	0-7	2-15	1.30-1.60	2.0-6.0	0.13-0.18	5.1-7.3	Low----------	0.24	5	3	1-3
	7-15	10-18	1.40-1.70	0.6-2.0	0.12-0.18	4.5-6.5	Low----------	0.24			
	15-43	5-15	1.60-1.75	0.6-6.0	0.12-0.14	5.1-6.5	Low----------	0.24			
	43-60	5-15	1.60-1.80	0.6-6.0	0.08-0.13	7.9-8.4	Low----------	0.24			
Riddles---------	0-8	4-14	1.35-1.45	2.0-6.0	0.13-0.18	5.6-7.3	Low----------	0.24	5	3	.5-2
	8-31	18-30	1.40-1.60	0.6-2.0	0.12-0.18	4.5-7.3	Moderate-----	0.32			
	31-40	15-30	1.40-1.60	0.6-2.0	0.16-0.19	6.6-7.8	Low----------	0.32			
	40-60	8-15	1.45-1.65	0.6-2.0	0.08-0.13	7.4-8.4	Low----------	0.32			
10E:											
Hillsdale-------	0-9	2-15	1.30-1.60	2.0-6.0	0.13-0.18	5.1-7.3	Low----------	0.24	5	3	1-3
	9-28	10-18	1.40-1.70	0.6-2.0	0.12-0.18	4.5-6.5	Low----------	0.24			
	28-43	5-15	1.60-1.75	0.6-6.0	0.12-0.14	5.1-6.5	Low----------	0.24			
	43-60	5-15	1.60-1.80	0.6-6.0	0.08-0.13	7.9-8.4	Low----------	0.24			
Riddles---------	0-10	4-14	1.35-1.45	2.0-6.0	0.13-0.18	5.6-7.3	Low----------	0.24	5	3	.5-2
	10-31	18-30	1.40-1.60	0.6-2.0	0.12-0.18	4.5-7.3	Moderate-----	0.32			
	31-40	15-30	1.40-1.60	0.6-2.0	0.16-0.19	6.6-7.8	Low----------	0.32			
	40-60	8-15	1.45-1.65	0.6-2.0	0.08-0.13	7.4-8.4	Low----------	0.32			
11B, 11C, 11D----	0-6	5-20	1.40-1.60	0.6-2.0	0.12-0.20	5.1-7.3	Low----------	0.28	4	8	1-2
Eleva	6-11	5-20	1.40-1.60	0.6-2.0	0.12-0.20	5.1-6.0	Low----------	0.17			
	11-18	10-18	1.45-1.65	2.0-6.0	0.12-0.14	5.1-6.0	Low----------	0.20			
	18-37	1-8	1.50-1.70	6.0-20	0.04-0.09	5.1-6.5	Low----------	0.10			
	37	---	---	---	---	---	----------	----			
12B:											
Williamstown----	0-10	14-26	1.30-1.45	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	0.37	4	5	1-3
	10-33	20-35	1.35-1.50	0.6-2.0	0.15-0.19	5.6-7.8	Moderate-----	0.37			
	33-60	16-26	1.70-1.90	0.2-0.6	0.05-0.10	7.4-8.4	Low----------	0.37			

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
12B:											
Conover	0-9	11-22	1.40-1.55	0.6-2.0	0.18-0.22	5.6-7.3	Low	0.28	5	5	2-3
	9-27	25-35	1.45-1.65	0.2-0.6	0.15-0.18	5.6-7.3	Moderate	0.28			
	27-60	15-32	1.55-1.90	0.2-0.6	0.05-0.19	7.4-8.4	Low	0.37			
12C2	0-6	11-22	1.30-1.45	0.6-2.0	0.20-0.24	5.6-7.3	Low	0.37	4	5	.5-3
Miami	6-24	27-35	1.45-1.65	0.6-2.0	0.15-0.20	5.1-6.0	Moderate	0.37			
	24-60	15-25	1.70-1.90	0.06-0.2	0.05-0.10	7.4-8.4	Moderate	0.37			
12D2	0-6	27-35	1.35-1.50	0.6-2.0	0.18-0.20	5.6-7.3	Moderate	0.37	3	6	.5-2
Miami	6-24	27-35	1.45-1.65	0.6-2.0	0.15-0.20	5.1-6.0	Moderate	0.37			
	24-60	15-25	1.70-1.90	0.06-0.2	0.05-0.10	7.4-8.4	Moderate	0.37			
12E	0-6	11-22	1.30-1.45	0.6-2.0	0.20-0.24	5.6-7.3	Low	0.37	4	5	.5-3
Miami	6-24	27-35	1.45-1.65	0.6-2.0	0.15-0.20	5.1-6.0	Moderate	0.37			
	24-60	15-25	1.70-1.90	0.06-0.2	0.05-0.10	7.4-8.4	Moderate	0.37			
13B	0-9	11-22	1.40-1.55	0.6-2.0	0.18-0.22	5.6-7.3	Low	0.28	5	5	2-3
Conover	9-27	25-35	1.45-1.65	0.2-0.6	0.15-0.18	5.6-7.3	Moderate	0.28			
	27-60	15-32	1.55-1.90	0.2-0.6	0.05-0.19	7.4-8.4	Low	0.37			
14	0-20	18-26	1.30-1.45	0.6-2.0	0.22-0.24	6.1-7.3	Moderate	0.28	5	6	2-5
Wolcott	20-32	27-35	1.55-1.65	0.6-2.0	0.15-0.19	6.1-7.8	Moderate	0.37			
	32-60	11-25	1.50-1.65	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
15B, 15C	0-11	0-10	1.35-1.60	6.0-20	0.08-0.12	5.6-7.3	Low	0.17	4	2	.5-3
Boyer	11-16	2-15	1.30-1.60	2.0-6.0	0.08-0.16	5.6-7.3	Low	0.17			
	16-23	10-18	1.35-1.60	2.0-6.0	0.11-0.13	5.6-7.8	Low	0.24			
	23-60	0-10	1.40-1.55	>20	0.02-0.04	7.4-8.4	Low	0.10			
15D2	0-5	0-10	1.30-1.60	2.0-6.0	0.06-0.10	5.6-7.3	Low	0.10	4	2	.5-3
Boyer	5-10	2-15	1.30-1.60	2.0-6.0	0.08-0.16	5.6-7.3	Low	0.17			
	10-24	10-18	1.35-1.60	2.0-6.0	0.11-0.13	5.6-7.8	Low	0.24			
	24-60	0-10	1.40-1.55	>20	0.02-0.04	7.4-8.4	Low	0.10			
15E	0-7	0-10	1.30-1.60	2.0-6.0	0.06-0.10	5.6-7.3	Low	0.10	4	2	.5-3
Boyer	7-16	2-15	1.30-1.60	2.0-6.0	0.08-0.16	5.6-7.3	Low	0.17			
	16-23	10-18	1.35-1.60	2.0-6.0	0.11-0.13	5.6-7.8	Low	0.24			
	23-60	0-10	1.40-1.55	>20	0.02-0.04	7.4-8.4	Low	0.10			
16B, 16C2	0-8	5-15	1.40-1.70	0.6-2.0	0.11-0.18	5.1-7.3	Low	0.24	4	3	1-3
Fox	8-34	18-35	1.55-1.65	0.6-2.0	0.10-0.19	5.1-8.4	Moderate	0.32			
	34-60	0-2	1.30-1.70	>6.0	0.02-0.07	7.4-8.4	Low	0.10			
16D2, 16E	0-8	20-35	1.55-1.65	0.6-2.0	0.13-0.20	5.1-7.3	Moderate	0.24	3	8	.5-2
Fox	8-34	18-35	1.55-1.65	0.6-2.0	0.10-0.19	5.1-8.4	Moderate	0.32			
	34-60	0-2	1.30-1.80	>6.0	0.02-0.07	7.4-8.4	Low	0.10			
17	0-11	10-25	1.10-1.60	0.6-2.0	0.18-0.25	6.1-7.8	Low	0.24	4	5	2-12
Sebewa	11-23	18-35	1.50-1.80	0.6-2.0	0.15-0.19	6.1-8.4	Moderate	0.32			
	23-60	0-3	1.55-1.75	>6.0	0.02-0.04	7.4-8.4	Low	0.10			
18B:											
Glynwood	0-7	27-38	1.35-1.55	0.2-0.6	0.17-0.23	5.1-7.8	Low	0.43	3	7	1-2
	7-26	35-55	1.45-1.70	0.06-0.2	0.11-0.18	4.5-7.8	Moderate	0.32			
	26-60	27-36	1.65-1.85	0.06-0.2	0.06-0.10	7.4-8.4	Moderate	0.32			
Blount	0-9	22-27	1.35-1.55	0.6-2.0	0.20-0.24	5.1-7.3	Low	0.43	3	6	2-3
	9-32	35-50	1.40-1.70	0.06-0.6	0.12-0.19	7.4-7.8	Moderate	0.43			
	32-60	27-38	1.60-1.85	0.06-0.6	0.07-0.10	7.4-8.4	Moderate	0.43			

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
18C2----------	0-6	22-27	1.35-1.55	0.6-2.0	0.20-0.24	5.1-7.3	Low----------	0.43	4	6	1-3
Morley	6-31	27-45	1.45-1.65	0.2-0.6	0.12-0.20	5.1-8.4	Moderate-----	0.43			
	31-60	27-40	1.60-1.80	0.06-0.6	0.07-0.12	6.1-8.4	Moderate-----	0.43			
18D2----------	0-6	27-35	1.40-1.60	0.2-0.6	0.18-0.20	5.1-7.3	Moderate-----	0.32	4	6	1-2
Morley	6-31	27-45	1.45-1.65	0.2-0.6	0.12-0.20	5.1-8.4	Moderate-----	0.43			
	31-60	27-40	1.60-1.80	0.06-0.6	0.07-0.12	6.1-8.4	Moderate-----	0.43			
18E----------	0-6	22-27	1.35-1.55	0.6-2.0	0.20-0.24	5.1-7.3	Low----------	0.43	4	6	1-3
Morley	6-31	27-45	1.45-1.65	0.2-0.6	0.12-0.20	5.1-8.4	Moderate-----	0.43			
	31-60	27-40	1.60-1.80	0.06-0.6	0.07-0.12	6.1-8.4	Moderate-----	0.43			
19B----------	0-9	22-27	1.35-1.55	0.6-2.0	0.20-0.24	5.1-7.3	Low----------	0.43	3	6	2-3
Blount	9-32	35-50	1.40-1.70	0.06-0.6	0.12-0.19	7.4-7.8	Moderate-----	0.43			
	32-60	27-38	1.60-1.85	0.06-0.6	0.07-0.10	7.4-8.4	Moderate-----	0.43			
20----------	0-11	18-27	1.35-1.55	0.6-2.0	0.20-0.24	6.1-7.3	Low----------	0.28	5	6	3-5
Pewamo	11-48	35-50	1.40-1.70	0.2-0.6	0.12-0.20	5.6-7.8	Moderate-----	0.28			
	48-60	30-40	1.50-1.70	0.2-0.6	0.14-0.18	7.4-8.4	Moderate-----	0.28			
24B, 24C, 24D----	0-9	2-15	1.40-1.70	6.0-20	0.08-0.10	5.1-7.3	Low----------	0.17	5	2	2-4
Spinks	9-60	3-18	1.40-1.70	2.0-6.0	0.04-0.08	5.6-7.8	Low----------	0.17			
25B----------	0-10	2-15	1.30-1.60	2.0-6.0	0.09-0.11	5.6-7.3	Low----------	0.17	5	2	1-4
Thetford	10-24	2-15	1.30-1.60	2.0-20	0.07-0.11	5.6-7.3	Low----------	0.17			
	24-60	8-18	1.45-1.65	2.0-6.0	0.06-0.08	5.6-7.8	Low----------	0.17			
29B, 29C, 29D----	0-9	5-18	1.30-1.60	2.0-6.0	0.11-0.15	6.1-7.3	Low----------	0.24	5	3	1-3
Steamburg	9-34	5-18	1.35-1.70	2.0-6.0	0.08-0.14	6.1-7.3	Low----------	0.24			
	34-40	18-35	1.35-1.70	0.2-0.6	0.16-0.20	6.1-7.8	Moderate-----	0.37			
	40-60	18-35	1.45-1.70	0.2-0.6	0.13-0.19	6.1-7.8	Moderate-----	0.37			
32----------	0-16	15-27	1.20-1.40	0.6-2.0	0.19-0.24	6.1-7.8	Low----------	0.28	5	6	3-6
Sloan	16-31	22-27	1.25-1.55	0.2-2.0	0.17-0.22	6.1-8.4	Moderate-----	0.37			
	31-60	10-28	1.20-1.50	0.2-2.0	0.11-0.22	6.6-8.4	Low----------	0.37			
33----------	0-9	---	0.20-0.35	0.2-6.0	0.35-0.45	4.5-7.8	----------	----	5	2	>70
Houghton	9-60	---	0.15-0.25	0.2-6.0	0.35-0.45	4.5-7.8	----------	----			
34----------	0-26	---	0.30-0.55	0.2-6.0	0.35-0.45	5.1-7.3	----------	----	4	2	55-75
Adrian	26-60	2-10	1.40-1.75	6.0-20	0.03-0.08	5.6-8.4	Low----------	0.15			
35----------	0-13	---	0.30-0.40	0.2-6.0	0.35-0.45	5.1-7.8	----------	----	5	2	>75
Palms	13-16	---	0.15-0.30	0.2-6.0	0.35-0.45	5.1-7.8	----------	----			
	16-60	7-35	1.45-1.75	0.2-2.0	0.14-0.22	6.1-8.4	Low----------	0.37			
37A----------	0-9	10-20	1.30-1.65	2.0-6.0	0.13-0.22	5.1-7.3	Low----------	0.28	4	5	2-4
Matherton	9-25	20-35	1.40-1.70	0.6-2.0	0.12-0.18	5.1-7.3	Moderate-----	0.24			
	25-60	0-10	1.50-1.65	>6.0	0.02-0.04	7.4-8.4	Low----------	0.10			
38----------	0-18	---	0.30-0.55	0.2-6.0	0.35-0.45	4.5-7.8	----------	----	4	2	55-75
Edwards	18-60	3-6	---	---	---	7.4-8.4	----------	----			
39----------	0-16	10-20	1.50-1.70	2.0-6.0	0.16-0.18	5.6-7.3	Low----------	0.20	4	3	2-4
Gilford	16-36	8-17	1.60-1.80	2.0-6.0	0.10-0.14	5.6-7.3	Low----------	0.20			
	36-42	3-12	1.70-1.90	6.0-20	0.05-0.08	6.1-7.3	Low----------	0.15			
	42-60	1-5	1.70-1.90	>20	0.02-0.04	7.9-8.4	Low----------	0.10			
40A----------	0-9	10-20	1.35-1.65	2.0-6.0	0.16-0.20	5.1-7.3	Low----------	0.20	5	3	2-4
Locke	9-37	18-25	1.40-1.70	0.6-2.0	0.14-0.18	5.1-8.4	Low----------	0.32			
	37-60	8-18	1.65-1.80	0.6-2.0	0.12-0.15	7.4-8.4	Low----------	0.32			

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
42B----------	0-10	4-14	1.35-1.45	2.0-6.0	0.13-0.18	5.6-7.3	Low----------	0.24	5	3	.5-2
Riddles	10-31	18-30	1.40-1.60	0.6-2.0	0.12-0.18	4.5-7.3	Moderate-----	0.32			
	31-40	15-22	1.40-1.60	0.6-2.0	0.11-0.19	6.6-7.8	Low----------	0.32			
	40-60	8-15	1.45-1.65	0.6-2.0	0.08-0.13	7.4-8.4	Low----------	0.32			
42C2, 42D2-------	0-8	4-14	1.35-1.45	2.0-6.0	0.13-0.18	5.6-7.3	Low----------	0.24	5	3	.5-2
Riddles	8-31	18-30	1.40-1.60	0.6-2.0	0.12-0.18	4.5-7.3	Moderate-----	0.32			
	31-40	15-22	1.40-1.60	0.6-2.0	0.11-0.19	6.6-7.8	Low----------	0.32			
	40-60	8-15	1.45-1.65	0.6-2.0	0.08-0.13	7.4-8.4	Low----------	0.32			
42E----------	0-10	4-14	1.35-1.45	2.0-6.0	0.13-0.18	5.6-7.3	Low----------	0.24	5	3	.5-2
Riddles	10-31	18-30	1.40-1.60	0.6-2.0	0.12-0.18	4.5-7.3	Moderate-----	0.32			
	31-40	15-22	1.40-1.60	0.6-2.0	0.11-0.19	6.6-7.8	Low----------	0.32			
	40-60	8-15	1.45-1.65	0.6-2.0	0.08-0.13	7.4-8.4	Low----------	0.32			
43:											
Histosols.											
Aquents.											
44B----------	0-8	2-18	1.40-1.70	0.6-6.0	0.08-0.12	5.6-7.3	Low----------	0.17	5	2	1-3
Leoni	8-34	18-35	1.40-1.70	0.6-2.0	0.06-0.12	5.1-7.3	Low----------	0.24			
	34-60	0-18	1.40-1.60	2.0-20	0.01-0.03	7.4-8.4	Low----------	0.10			
44C2, 44D2-------	0-8	2-18	1.40-1.70	0.6-6.0	0.06-0.10	5.6-7.3	Low----------	0.17	5	8	1-3
Leoni	8-30	18-35	1.40-1.70	0.6-2.0	0.06-0.12	5.1-7.3	Low----------	0.24			
	30-60	0-18	1.40-1.60	2.0-20	0.01-0.03	7.4-8.4	Low----------	0.10			
45----------	0-14	---	0.30-0.40	0.2-6.0	0.35-0.45	<4.5	----------	----	5	2	70-90
Napoleon	14-60	---	0.10-0.20	0.6-6.0	0.45-0.55	<4.5	----------	----			
46----------	0-6	10-27	1.15-1.40	0.6-2.0	0.16-0.21	5.1-7.8	Low----------	0.37	5	---	4-12
Wallkill	6-34	15-27	1.15-1.45	0.6-2.0	0.15-0.20	5.1-7.8	Low----------	0.37			
	34-60	---	0.25-0.45	2.0-20	0.35-0.45	5.6-7.8	----------	----			
50B, 50C, 50E----	0-9	0-10	1.35-1.65	6.0-20	0.05-0.09	4.5-7.3	Low----------	0.15	5	1	.5-2
Coloma	9-35	0-10	1.35-1.65	6.0-20	0.05-0.12	4.5-7.3	Low----------	0.15			
	35-60	2-12	1.50-1.65	6.0-20	0.03-0.08	4.5-6.5	Low----------	0.15			
51----------	0-16	5-15	1.00-1.35	6.0-20	0.14-0.16	5.6-7.8	Low----------	0.17	5	2	10-15
Glendora	16-60	0-10	1.40-1.65	6.0-20	0.05-0.11	5.6-7.8	Low----------	0.17			
55.											
Pits											
57----------	0-8	18-27	1.30-1.50	0.6-2.0	0.22-0.24	6.1-7.8	Low----------	0.37	5	6	2-5
Shoals	8-30	18-27	1.35-1.55	0.6-2.0	0.17-0.22	6.1-7.8	Low----------	0.37			
	30-60	12-25	1.35-1.60	0.6-2.0	0.12-0.21	6.6-8.4	Low----------	0.37			
58B----------	0-8	3-15	1.40-1.60	6.0-20	0.08-0.10	5.1-7.3	Low----------	0.17	4	2	.5-3
Seward	8-35	2-15	1.40-1.60	6.0-20	0.09-0.11	5.1-7.3	Low----------	0.17			
	35-40	5-18	1.50-1.70	2.0-6.0	0.10-0.16	5.1-7.3	Low----------	0.17			
	40-60	30-40	1.60-1.82	<0.2	0.14-0.20	6.1-8.4	High----------	0.32			

TABLE 18.--WATER FEATURES

("Flooding" and "water table" and terms such as "occasional," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding			High water table		
		Frequency	Duration	Months	Depth	Kind	Months
					Ft		
10B, 10C2, 10D2, 10E: Hillsdale	B	None	---	---	>6.0	---	---
Riddles	B	None	---	---	>6.0	---	---
11B, 11C, 11D--- Eleva	B	None	---	---	>6.0	---	---
12B: Williamstown	C	None	---	---	1.5-3.5	Perched	Jan-Apr
Conover	C	None	---	---	1.0-2.0	Apparent	Nov-May
12C2, 12D2, 12E--- Miami	B	None	---	---	>6.0	---	---
13B--- Conover	C	None	---	---	1.0-2.0	Apparent	Nov-May
14--- Wolcott	B/D	None	---	---	+.5-1.0	Apparent	Dec-May
15B, 15C, 15D2, 15E--- Boyer	B	None	---	---	>6.0	---	---
16B, 16C2, 16D2, 16E--- Fox	B	None	---	---	>6.0	---	---
17--- Sebewa	B/D	None	---	---	+1-1.0	Apparent	Sep-May
18B: Glynwood	C	None	---	---	2.0-3.5	Perched	Jan-Apr
Blount	C	None	---	---	1.0-3.0	Perched	Jan-May
18C2, 18D2, 18E--- Morley	C	None	---	---	>6.0	---	---
19B--- Blount	C	None	---	---	1.0-3.0	Perched	Jan-May
20--- Pewamo	C/D	None	---	---	+1-1.0	Apparent	Dec-May
24B, 24C, 24D--- Spinks	A	None	---	---	>6.0	---	---
25B--- Thetford	A	None	---	---	1.0-2.0	Apparent	Feb-May
29B, 29C, 29D--- Steamburg	B	None	---	---	>6.0	---	---

TABLE 18.--WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table		
		Frequency	Duration	Months	Depth	Kind	Months
					Ft		
32---------- Sloan	B/D	Frequent--------	Brief---------	Nov-Jun	0-1.0	Apparent	Nov-Jun
33---------- Houghton	A/D	None----------	---	---	+1-1.0	Apparent	Sep-Jun
34---------- Adrian	A/D	None----------	---	---	+1-1.0	Apparent	Nov-May
35---------- Palms	A/D	None----------	---	---	+1-1.0	Apparent	Nov-May
37A---------- Matherton	B	None----------	---	---	1.0-2.0	Apparent	Nov-May
38---------- Edwards	B/D	None----------	---	---	+1-1.0	Apparent	Sep-Jun
39---------- Gilford	B/D	None----------	---	---	+.5-1.0	Apparent	Dec-May
40A---------- Locke	B	None----------	---	---	1.0-2.0	Apparent	Nov-May
42B, 42C2, 42D2, 42E---- Riddles	B	None----------	---	---	>6.0	---	---
43: Histosols. Aquents.							
44B, 44C2, 44D2--------- Leoni	B	None----------	---	---	>6.0	---	---
45---------- Napoleon	A/D	None----------	---	---	+1-1.0	Apparent	Sep-Jun
46---------- Wallkill	C/D	Occasional------	Brief or long	Sep-Jun	+.5-1.0	Apparent	Sep-Jun
50B, 50C, 50E---------- Coloma	A	None----------	---	---	>6.0	---	---
51---------- Glendora	A/D	Frequent--------	Long----------	Jan-Dec	0-1.0	Apparent	Nov-Jun
55. Pits							
57---------- Shoals	C	Occasional------	Brief---------	Oct-Jun	0.5-1.5	Apparent	Jan-Apr
58B---------- Seward	B	None----------	---	---	1.5-4.0	Perched	Jan-Apr

TABLE 19.--SOIL FEATURES

(The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Bedrock		Subsidence		Potential frost action	Risk of corrosion	
	Depth	Hardness	Initial	Total		Uncoated steel	Concrete
	In		In	In			
10B, 10C2, 10D2, 10E: Hillsdale	>60	---	---	---	Moderate	Low	High.
Riddles	>60	---	---	---	Moderate	Moderate	Moderate.
11B, 11C, 11D Eleva	20-40	Soft	---	---	Moderate	Low	Moderate.
12B: Williamstown	>60	---	---	---	High	Moderate	Low.
Conover	>60	---	---	---	High	High	Moderate.
12C2, 12D2, 12E Miami	>60	---	---	---	Moderate	Moderate	Moderate.
13B Conover	>60	---	---	---	High	High	Moderate.
14 Wolcott	>60	---	---	---	High	High	Low.
15B, 15C, 15D2, 15E Boyer	>60	---	---	---	Moderate	Low	Moderate.
16B, 16C2 Fox	>60	---	---	---	Moderate	Moderate	Moderate.
16D2, 16E Fox	>60	---	---	---	Moderate	Low	Moderate.
17 Sebewa	>60	---	---	---	High	High	Low.
18B: Glynwood	>60	---	---	---	High	High	Moderate.
Blount	>60	---	---	---	High	High	High.
18C2, 18D2, 18E Morley	>60	---	---	---	Moderate	High	Moderate.
19B Blount	>60	---	---	---	High	High	High.
20 Pewamo	>60	---	---	---	High	High	Low.
24B, 24C, 24D Spinks	>60	---	---	---	Low	Low	Low.
25B Thetford	>60	---	---	---	Moderate	Low	Moderate.
29B, 29C, 29D Steamburg	>60	---	---	---	Moderate	Moderate	Moderate.

See footnote at end of table.

TABLE 19.--SOIL FEATURES--Continued

Soil name and map symbol	Bedrock		Subsidence		Potential frost action	Risk of corrosion	
	Depth	Hardness	Initial	Total		Uncoated steel	Concrete
	In		In	In			
32---------- Sloan	>60	---	---	---	High----------	High----------	Low.
33---------- Houghton	>60	---	6-18	55-60	High----------	High----------	Moderate.
34---------- Adrian	>60	---	6-18	29-33	High----------	High----------	Moderate.
35---------- Palms	>60	---	4-15	25-32	High----------	High----------	Moderate.
37A---------- Matherton	>60	---	---	---	High----------	Moderate-------	Low.
38---------- Edwards	>60	---	4-12	25-30	High----------	High----------	Low.
39---------- Gilford	>60	---	---	---	High----------	High----------	Moderate.
40A---------- Locke	>60	---	---	---	High----------	High----------	Moderate.
42B, 42C2, 42D2, 42E---- Riddles	>60	---	---	---	Moderate-------	Moderate-------	Moderate.
43: Histosols.							
Aquents.							
44B, 44C2, 44D2--------- Leoni	>60	---	---	---	Moderate-------	Low----------	Moderate.
45---------- Napoleon	>60	---	22-26	50-59	High----------	Moderate-------	High.
46---------- Wallkill	>60	---	---	---	High----------	Moderate-------	Moderate.
50B, 50C, 50E---------- Coloma	>60	---	---	---	Low----------	Low----------	Moderate.
51---------- Glendora	>60	---	---	---	Moderate-------	High----------	Moderate.
55. Pits							
57---------- Shoals	>60	---	---	---	High----------	High----------	Low.
58B---------- Seward	>60	---	---	---	Moderate-------	High----------	Moderate.

TABLE 20.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

Soil name	Family or higher taxonomic class
Adrian	Sandy or sandy-skeletal, mixed, euic, mesic Terric Medisaprists
Aquents	Aquents
Blount	Fine, illitic, mesic Aeric Ochraqualfs
Boyer	Coarse-loamy, mixed, mesic Typic Hapludalfs
Coloma	Mixed, mesic Alfic Udipsamments
Conover	Fine-loamy, mixed, mesic Udollic Ochraqualfs
Edwards	Marly, euic, mesic Limnic Medisaprists
Eleva	Coarse-loamy, mixed, mesic Typic Hapludalfs
Fox	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludalfs
Gilford	Coarse-loamy, mixed, mesic Typic Haplaquolls
*Glendora	Mixed, mesic Mollic Psammaquents
Glynwood	Fine, illitic, mesic Aquic Hapludalfs
Hillsdale	Coarse-loamy, mixed, mesic Typic Hapludalfs
Histosols	Histosols
Houghton	Euic, mesic Typic Medisaprists
Leoni	Loamy-skeletal, mixed, mesic Typic Hapludalfs
Locke	Fine-loamy, mixed, mesic Aquollic Hapludalfs
Matherton	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Udollic Ochraqualfs
Miami	Fine-loamy, mixed, mesic Typic Hapludalfs
Morley	Fine, illitic, mesic Typic Hapludalfs
Napoleon	Dysic, mesic Typic Medihemists
Palms	Loamy, mixed, euic, mesic Terric Medisaprists
Pewamo	Fine, mixed, mesic Typic Argiaquolls
Riddles	Fine-loamy, mixed, mesic Typic Hapludalfs
Sebewa	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Argiaquolls
Seward	Loamy, mixed, mesic Arenic Hapludalfs
Shoals	Fine-loamy, mixed, nonacid, mesic Aeric Fluvaquents
Sloan	Fine-loamy, mixed, mesic Fluvaquentic Haplaquolls
Spinks	Sandy, mixed, mesic Psammentic Hapludalfs
Steamburg	Coarse-loamy, mixed, mesic Typic Glossudalfs
Thetford	Sandy, mixed, mesic Psammaquentic Hapludalfs
Wallkill	Fine-loamy, mixed, nonacid, mesic Thapto-Histic Fluvaquents
Williamstown	Fine-loamy, mixed, mesic Aquic Hapludalfs
Wolcott	Fine-loamy, mixed, mesic Typic Haplaquolls

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