United States
Department of
Agriculture

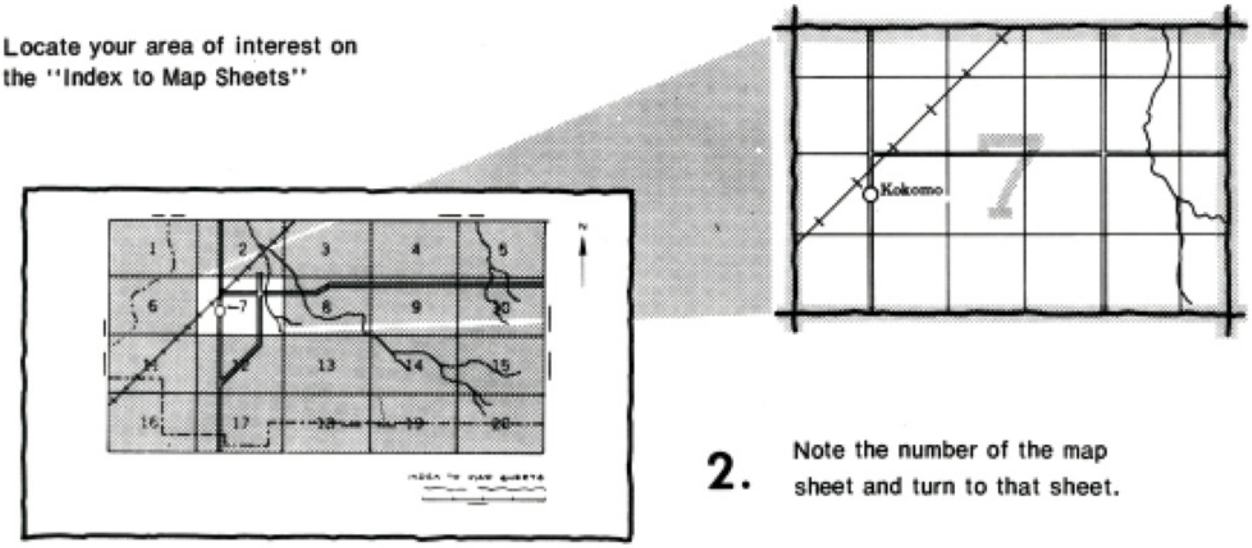
Soil
Conservation
Service

In cooperation with
Purdue University
Agricultural Experiment
Station and
Indiana Department of
Natural Resources,
Soil and Water
Conservation Committee

Soil Survey of Grant County, Indiana

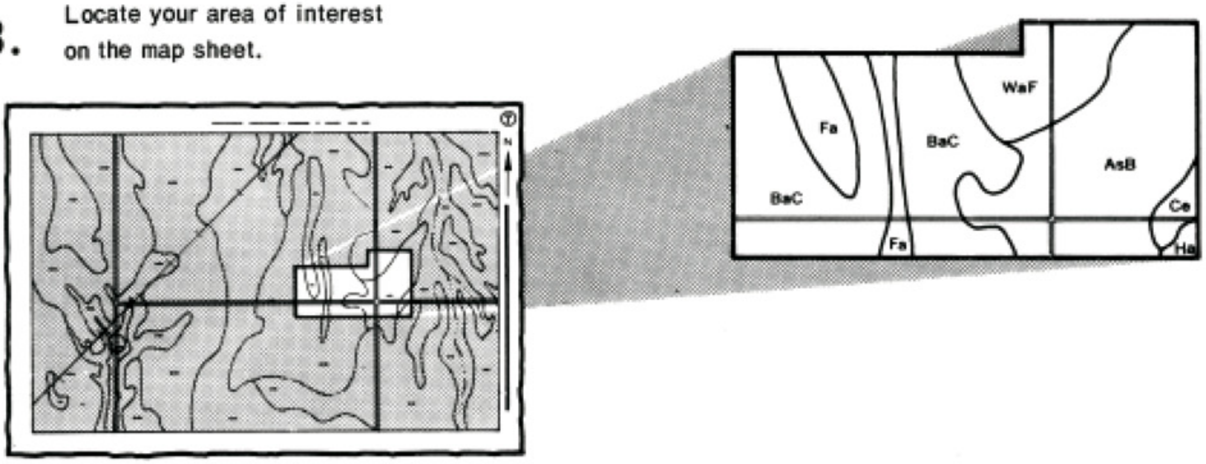
HOW TO USE

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

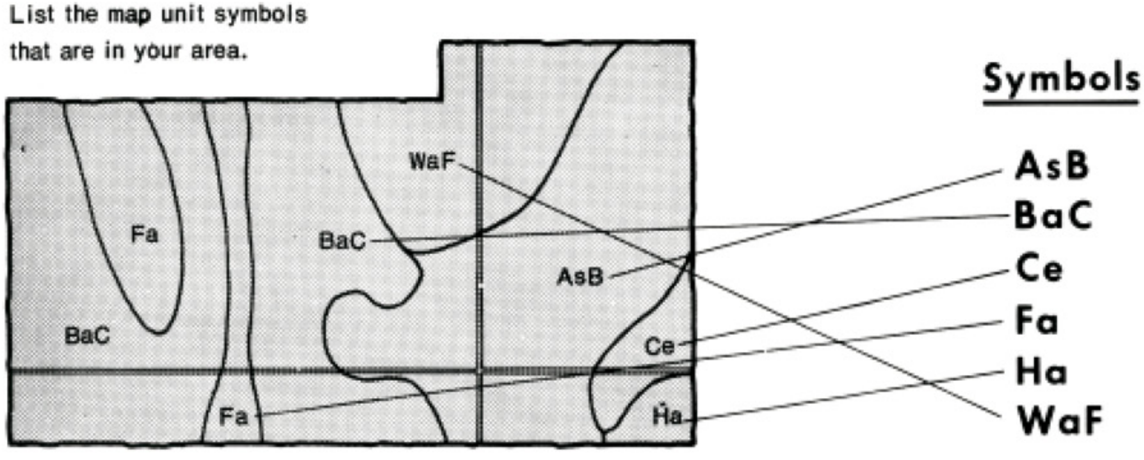


2. Note the number of the map sheet and turn to that sheet.

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

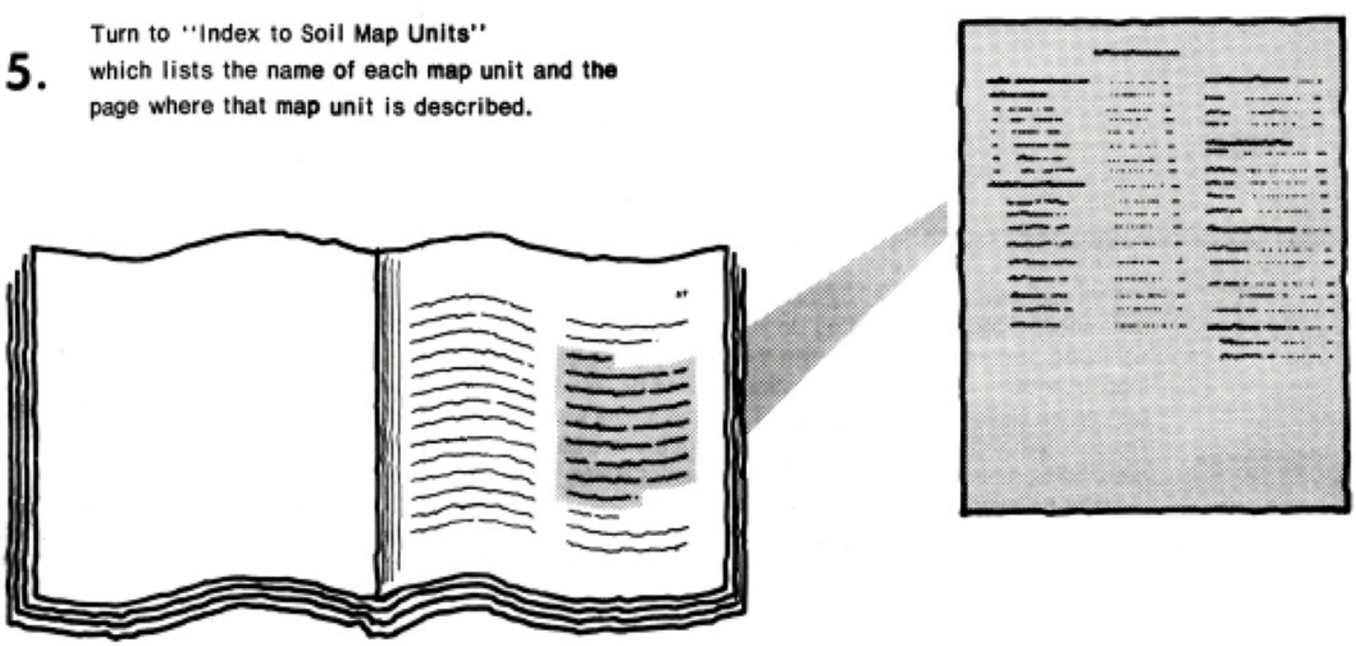


4. List the map unit symbols that are in your area.

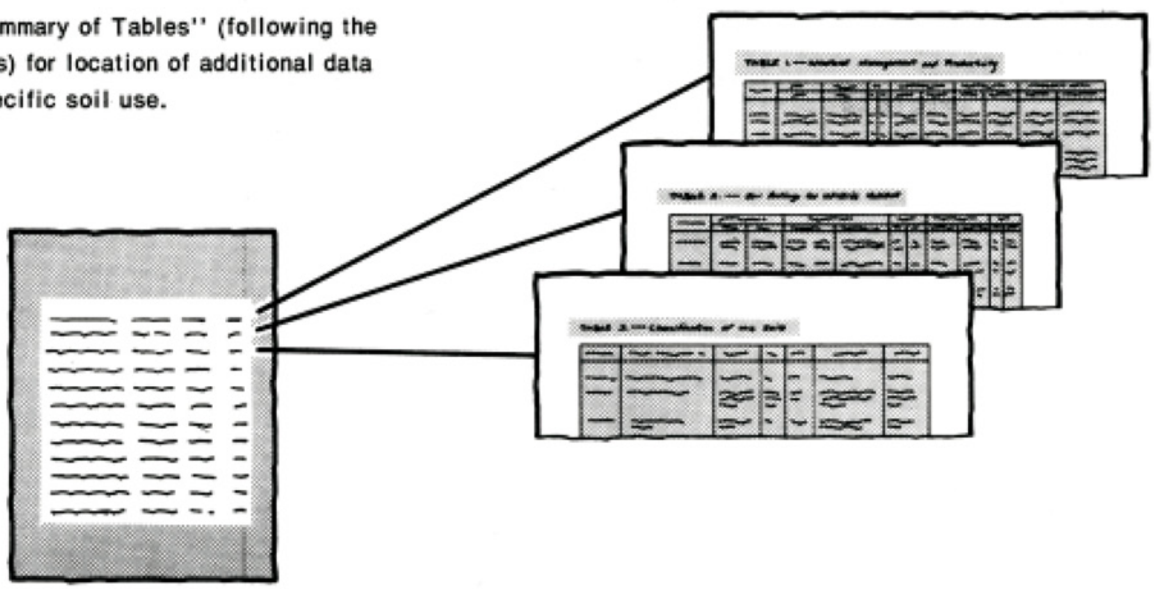


THIS SOIL SURVEY

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



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



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

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

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

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

Cover: Corn on Blount silty clay loam, 1 to 3 percent slopes, eroded.

Contents

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Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Grant County, Indiana. 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 Soil Conservation Service or the Cooperative Extension Service.

Robert L. Eddleman
State Conservationist
Soil Conservation Service

Location of Grant County in Indiana.

Soil Survey of Grant County, Indiana

By Earnest L. Jensen, Soil Conservation Service

Fieldwork by Earnest L. Jensen, Soil Conservation Service, and
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Indiana Department of Natural Resources, Soil and Water Conservation
Committee

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

GRANT COUNTY is in northeastern Indiana. It has a total area of 265,511 acres, or 415 square miles. It extends about 19 miles from north to south and 22 miles from east to west. Marion, the county seat, is in the central part of the county. Businesses within the county employ a large share of the work force, about half of which is engaged in manufacturing.

This soil survey updates the survey of Grant County published in 1917. It provides additional information and larger maps, which show the soils in greater detail (*5*).

General Nature of the County

This section gives general information concerning Grant County. It describes settlement, geology, relief and drainage, natural resources, transportation facilities, and climate.

Settlement

The first permanent settlement in the survey area is presumed to be that of Martin Boots. It was established at the mouth of Boots Creek in 1826. Boots built the first sawmill and gristmill in the county (*4*). The county was named in honor of Captain Samuel Grant and Moses Grant after it was created by an act of the Indiana General Assembly in 1831. The present boundaries were not established until 1839 (*4*). Taylor University was established in 1846 and Marion College in 1920.

The population of Grant County was 62,156 in 1950; 75,741 in 1960; 83,955 in 1970; and 80,679 in 1980 (*6*). Marion had a population of 30,081 in 1950; 37,854 in 1960; 40,253 in 1970; and 35,833 in 1980 (*6*). The county has smaller communities, some of which are Fairmount, Gas City, Jonesboro, Swayzee, and Upland.

Geology

Glaciation has played a major role in the formation of the topography in Grant County. Ice flowed across Indiana from the northeast. Acting as an erosional agent, it altered the landscape. Erosional debris incorporated within the flowing ice sheet was deposited along the outer edge of the glacier. As the ice retreated, it left behind a relatively flat plain, or ground moraine (*2, 7*). During periods when the front remained stationary, sediment accumulated, forming an irregular ridge, called an end moraine (*2, 7*). Thus, the glacier produced a new landscape consisting of a series of long, concentric ridges separated by nearly level plains, both of which are underlain by nonsorted, unstratified sediment, called till.

The glacial material in Grant County was deposited over sedimentary rocks of Silurian and Ordovician age. Bedrock of Silurian age is exposed in areas along the Mississinewa River north of Marion and in stone quarries in the western part of the county (fig. 1). Siltstone interbedded with limestone underlies the terraces in areas along the Mississinewa River north of Marion.

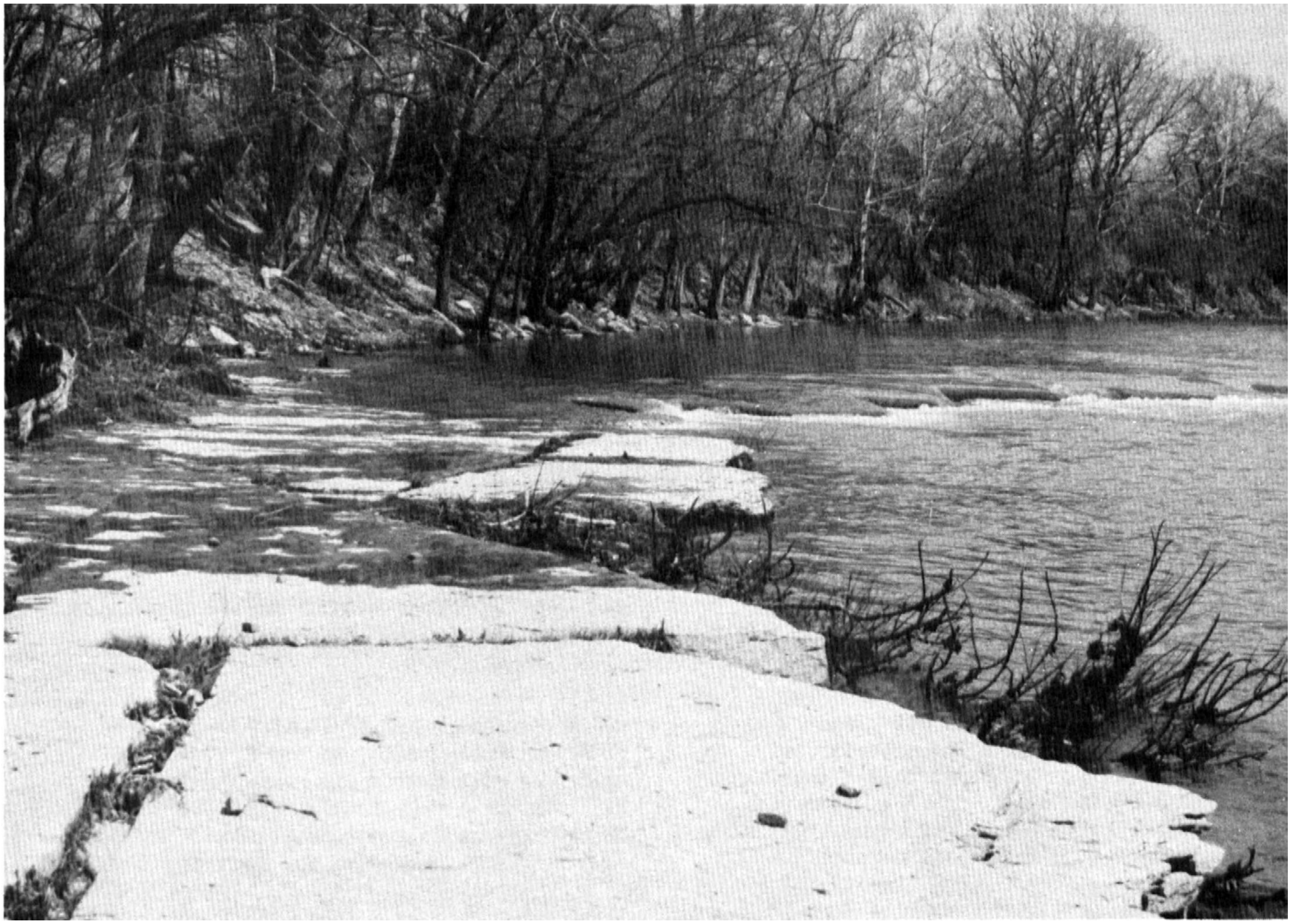

Figure 1.—Bedrock of Silurian age exposed in an area along the Mississinewa River north of Marion.

The Teays River Valley, which developed prior to glaciation, is still evident in Grant County, but it is completely filled with glacial drift. The Teays River headed in the Piedmont in North Carolina and flowed northwestward across West Virginia and Ohio, then westward across Indiana. It entered Grant County from the east, in an area near Arcana, and flowed northwestward across the county. It continued in a winding pattern westward across Indiana and southwestward across Illinois to the Mississippi River Valley (*7*).

Relief and Drainage

The average elevation in Grant County is about 845 feet above sea level. The highest elevation, which is near Upland, is approximately 950 feet. The lowest is 740 feet. It is in an area where the Mississinewa River leaves the county, north of Jalapa.

The county has six major areas of significantly different physiography. These are (1) the Tipton Till Plain, a nearly level area in the southwest corner of the county (*7*); (2) the Union City End Moraine, a gently sloping area extending across the southwest corner; (3) the nearly level area extending from the Union City End Moraine to the Mississinewa River; (4) the Union City Ground Moraine, which consists of predominantly well drained, nearly level to moderately sloping soils on terraces and bottom land along the Mississinewa River; (5) the area along the Mississinewa End Moraine, where the topography varies greatly; and (6) the Mississinewa Ground Moraine, a gently sloping area north and east of the more rugged land along the Mississinewa River.

The Mississinewa River enters the county near the southeast corner and flows northwest past Matthews, Gas City, Jonesboro, and Marion before leaving the county. Its tributaries are Tenmile, Cart, Boots, Deer, Back, Barren, Walnut, Lugar, Massey, Hummel, and Metocinah Creeks. The first five of these creeks drain most of the areas west of the Mississinewa River, and the rest drain the central and eastern parts of the county. Black Creek, a tributary of the Salamonie River, drains the northeastern part. Pipe Creek, a tributary of the Wabash River, drains the west-central part. Prairie Run, Grassy Fork, and Middle Fork drain the southwestern part of the county. They are tributaries of Wildcat Creek, which is a tributary of the Wabash River.

Natural Resources

Soil is the most important natural resource in the county, It provides a growing medium for corn, soybeans, and wheat and for the grasses grazed by livestock. Other natural resources are limestone, sand, and gravel, which are mined along the Mississinewa River and its tributaries and in two limestone quarries in the western part of the county. At one time appreciable amounts of oil and natural gas were extracted in Grant County. This activity resulted in a period of rapid economic growth in both Marion and Gas City.

Transportation Facilities

Interstate Highway 69 and State Roads 9, 13, 15, 18, 22, 26, and 37 are the major transportation routes in the county. Most of the county roads are paved. A few are graveled.

The county has three main railroad lines. It has no large airports, but an airport near Marion serves small private planes. Marion has excellent trucking service.

Climate

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

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

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

In winter the average temperature is 27 degrees F, and the average daily minimum temperature is 18 degrees. The lowest temperature on record, which occurred at Marion on January 29, 1963, is -20 degrees. In summer the average temperature is 71 degrees, and the average daily maximum temperature is 83 degrees. The highest recorded temperature, which occurred at Marion on June 30, 1952, is 101 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 (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 36.38 inches. Of this, 22.7 inches, or about 62 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 19 inches. The heaviest 1-day rainfall during the period of record was 5.65 inches at Marion on June 9, 1958. Thunderstorms occur on about 45 days each year, and most occur in summer. Tornadoes and severe thunderstorms occur occasionally. These storms are usually local in extent and of short duration and cause damage in scattered areas.

The average seasonal snowfall is about 25 inches. The greatest snow depth at any one time during the period of record was 11 inches. On the average, 17 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

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

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 biologic activity.

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

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

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

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

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

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

Map Unit Composition

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

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

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

General Soil Map Units

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

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

Soil Descriptions

Nearly Level and Gently Sloping Soils That Are Very Poorly Drained to Moderately Well Drained; on Uplands

These soils are on broad till plains and moraines. They make up about 54 percent of the county. Most areas are drained and are used for cultivated crops. Wetness and ponding are the main management concerns. Erosion is a hazard in the gently sloping areas.

1. Pewamo-Blount

Deep, nearly level, very poorly drained to somewhat poorly drained, moderately fine textured and medium textured soils formed in glacial till and in silty material over glacial till; on till plains and moraines

This map unit consists of soils in broad depressional areas and on slight rises. Slopes range from 0 to 2 percent.

This map unit makes up about 40 percent of the county. It is about 59 percent Pewamo soils, 36 percent Blount soils, and 5 percent minor soils (fig. 2).

The poorly drained and very poorly drained Pewamo soils are in broad depressional areas. Typically, they have a surface layer of very dark gray silty clay loam and a subsoil of dark gray and gray, mottled silty clay loam and clay loam.

The somewhat poorly drained Blount soils are on slight rises. Typically, they have a surface layer of dark grayish brown silt loam and a subsoil of dark yellowish brown, yellowish brown, and brown, mottled silty clay loam, clay, and clay loam.

Minor in this map unit are the moderately well drained Glynwood soils on ridges and knolls, the well drained Morley soils on the more sloping side slopes, and the very poorly drained Sloan soils in depressions on flood plains.

Most areas are cultivated. The major soils are well suited to cultivated crops. Wetness and ponding are the main management concerns. The Pewamo soils are subject to ponding during periods of heavy precipitation.

The major soils are well suited to grasses and legumes for hay or pasture. Wetness and ponding are the main management concerns. Overgrazing or grazing when the soils are wet causes surface compaction and poor tilth.

The major soils are fairly well suited to trees. Wetness and the content of clay in the upper part of the soil profile are limitations.

The Blount soils are poorly suited to building site development and sanitary facilities because of wetness and moderately slow or slow permeability. The Pewamo soils are generally unsuitable for these uses because of ponding.

2. Pewamo-Glynwood

Deep, nearly level and gently sloping, poorly drained, very poorly drained, and moderately well drained, moderately fine textured and medium textured soils formed in glacial till and in silty material over glacial till; on till plains and moraines

This map unit consists of soils in depressions and on ridges and knolls. Slopes range from 0 to 6 percent.

This map unit makes up about 6 percent of the county.

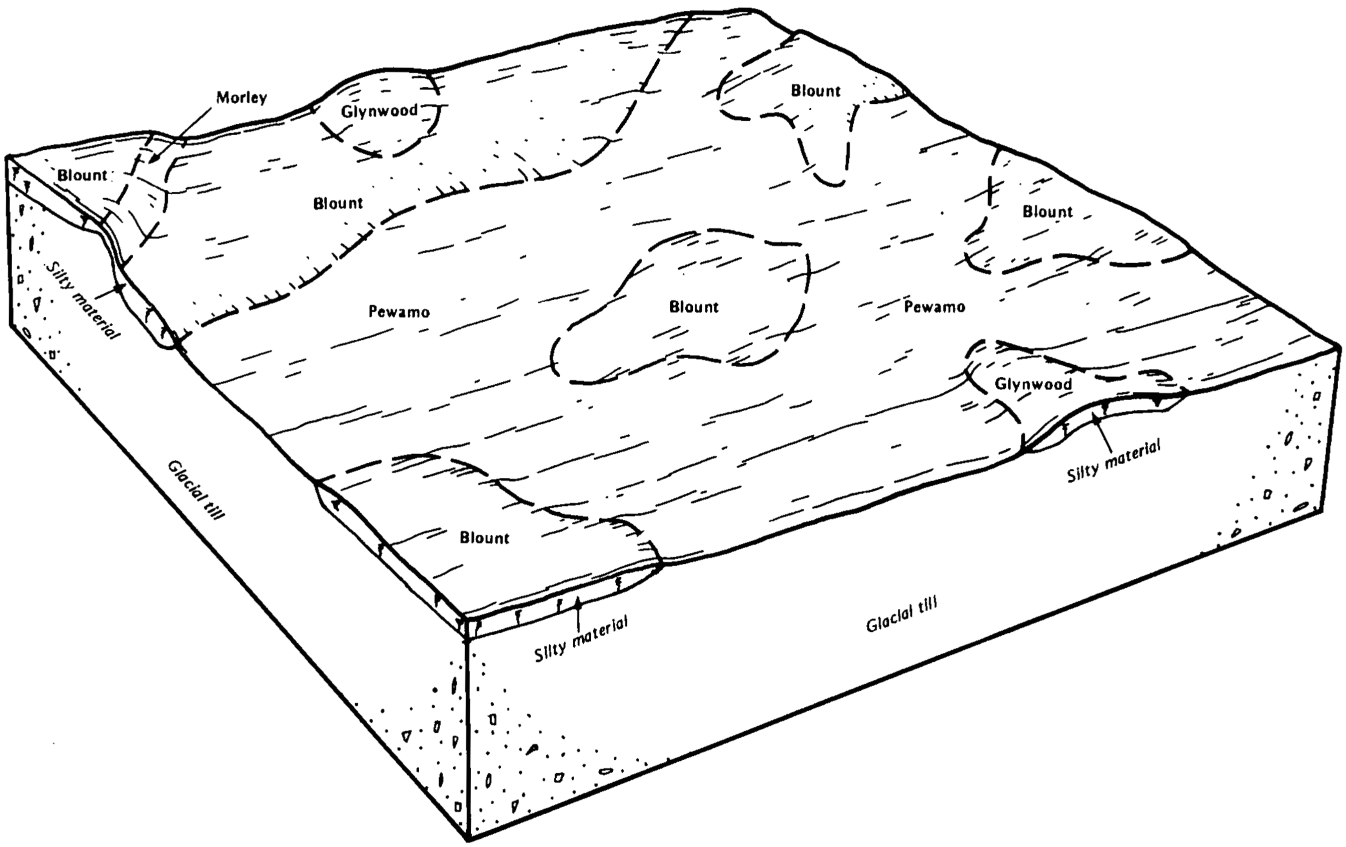

Figure 2.—Pattern of soils and parent material in the Pewamo-Blount map unit.

It is about 53 percent Pewamo soils, 36 percent Glynwood soils, and 11 percent minor soils.

The poorly drained and very poorly drained, nearly level Pewamo soils are in depressional areas. Typically, they have a surface layer of very dark gray silty clay loam and a subsoil of dark gray and gray, mottled silty clay loam and clay loam.

The moderately well drained, gently sloping Glynwood soils are on ridges and knolls. Typically, they have a surface layer of brown silt loam and a subsoil of yellowish brown and dark yellowish brown, mottled silty clay loam and clay loam.

Minor in this map unit are the somewhat poorly drained Blount soils on slight rises, the very poorly drained Houghton soils in depressions, and the well drained Morley soils on ridges.

Most areas are cultivated. The major soils are well suited to cultivated crops. Wetness, ponding, and erosion are the main management concerns. The Pewamo soils are subject to ponding during periods of heavy precipitation. Removing the plant cover increases the susceptibility of the Glynwood soils to erosion.

The major soils are well suited to grasses and legumes for hay or pasture. Wetness, ponding, and erosion are the main management concerns. Excessive runoff also is a concern of the Glynwood soils. Overgrazing or grazing when the soils are wet causes surface compaction and poor tilth.

The major soils are fairly well suited to trees. Wetness and the content of clay in the upper part of the soil profile are limitations.

The Glynwood soils are poorly suited to building site development and sanitary facilities because of wetness and slow permeability. The Pewamo soils are generally unsuitable for these uses because of ponding and moderately slow permeability.

3. Glynwood-Pewamo-Blount

Deep, gently sloping and nearly level, moderately well drained to very poorly drained, medium textured and moderately fine textured soils formed in silty material over glacial till and in glacial till; on till plains and moraines

This map unit consists of soils on ridges and knolls, in broad depressions, and on slight rises. Slopes range from 0 to 6 percent.

This map unit makes up about 8 percent of the county. It is about 46 percent Glynwood soils, 23 percent Pewamo soils, 15 percent Blount soils, and 16 percent minor soils.

The moderately well drained, gently sloping Glynwood soils are on ridges and knolls. Typically, they have a surface layer of brown silt loam and a subsoil of yellowish brown and dark yellowish brown, mottled silty clay loam and clay loam.

The poorly drained and very poorly drained, nearly level Pewamo soils are in broad depressions. Typically, they have a surface layer of very dark gray silty clay loam and a subsoil of dark gray and gray, mottled silty clay loam and clay loam.

The somewhat poorly drained, nearly level Blount soils are on slight rises. Typically, they have a surface layer of dark grayish brown silt loam and a subsoil of dark yellowish brown, yellowish brown, and brown, mottled silty clay loam, clay, and clay loam.

Minor in this map unit are the well drained Fox soils in nearly level areas and on ridges and knolls on terraces, the very poorly drained Millgrove soils in depressions on terraces, the well drained Morley soils on ridges, the well drained Ockley soils in nearly level areas on terraces, and the very poorly drained Sloan soils in depressions on flood plains.

Most areas are cultivated. The major soils are well suited to cultivated crops. Erosion, wetness, and ponding are the main management concerns. Removing the plant cover increases the susceptibility of the Glynwood soils to erosion. Pewamo soils are subject to ponding during periods of heavy precipitation.

The major soils are well suited to grasses and legumes for hay or pasture. Erosion, wetness, and ponding are the main management concerns. Overgrazing or grazing when the soils are wet causes surface compaction, excessive runoff, and poor tilth.

The major soils are fairly well suited to trees. Wetness and the content of clay in the upper part of the soil profile are limitations.

The Glynwood and Blount soils are poorly suited to building site development and sanitary facilities because of wetness and slow or moderately slow permeability. The Pewamo soils are generally unsuitable for these uses because of ponding and moderately slow permeability.

Nearly Level to Strongly Sloping Soils That Are Well Drained and Moderately Well Drained; on Terraces and Flood Plains

These soils make up about 3 percent of the county. Most areas are used for cultivated crops. Erosion, droughtiness, and flooding are the main management concerns.

4. Fox-Landes

Nearly level to strongly sloping, well drained and moderately well drained, moderately fine textured to moderately coarse textured soils that formed in loamy sediments and are moderately deep over sand and gravel or that formed in alluvium and are deep; on terraces and flood plains

This map unit makes up about 3 percent of the county. It is about 55 percent Fox soils, 19 percent Landes soils, and 26 percent minor soils (fig. 3). Slopes of the major soils range from 0 to 15 percent.

The well drained, nearly level to strongly sloping Fox soils are on terraces. They are in nearly level areas, on ridges, and on knolls. Typically, they have a surface layer of brown silt loam or clay loam and a subsoil of dark yellowish brown, brown, and dark reddish brown clay loam and gravelly sandy clay loam.

The well drained and moderately well drained, nearly level Landes soils are on slight rises on flood plains. Typically, they have a surface soil of very dark grayish brown sandy loam and a subsoil of dark yellowish brown and brown sandy loam.

Minor in this map unit are the well drained Fox Variant soils in nearly level areas and on ridges and knolls on terraces, the well drained Ockley soils in nearly level areas on terraces, the very poorly drained Millgrove soils in depressions on terraces, and the very poorly drained Sloan soils in depressions on flood plains.

Most areas are cultivated. The major soils are well suited to cultivated crops. Erosion, droughtiness, and occasional flooding are the main management concerns. Removing the plant cover from the gently sloping to strongly sloping Fox soils increases the susceptibility to erosion. Late planting or replanting may be necessary because of flooding on the Landes soils.

The major soils are well suited to grasses and legumes for hay or pasture. Erosion, droughtiness, and occasional flooding are the main management concerns. Excessive runoff also is a concern on the gently sloping to strongly sloping Fox soils. Overgrazing or grazing when the soils are wet causes surface compaction and poor tilth.

The major soils are well suited to trees. No major hazards or limitations affect planting or harvesting.

The Fox soils are well suited to building site development, but the slope is a limitation in the moderately sloping and strongly sloping areas. These soils are poorly suited to sanitary facilities because of a poor filtering capacity. The Landes soils are generally unsuitable as sites for buildings and sanitary facilities because of the occasional flooding and a poor filtering

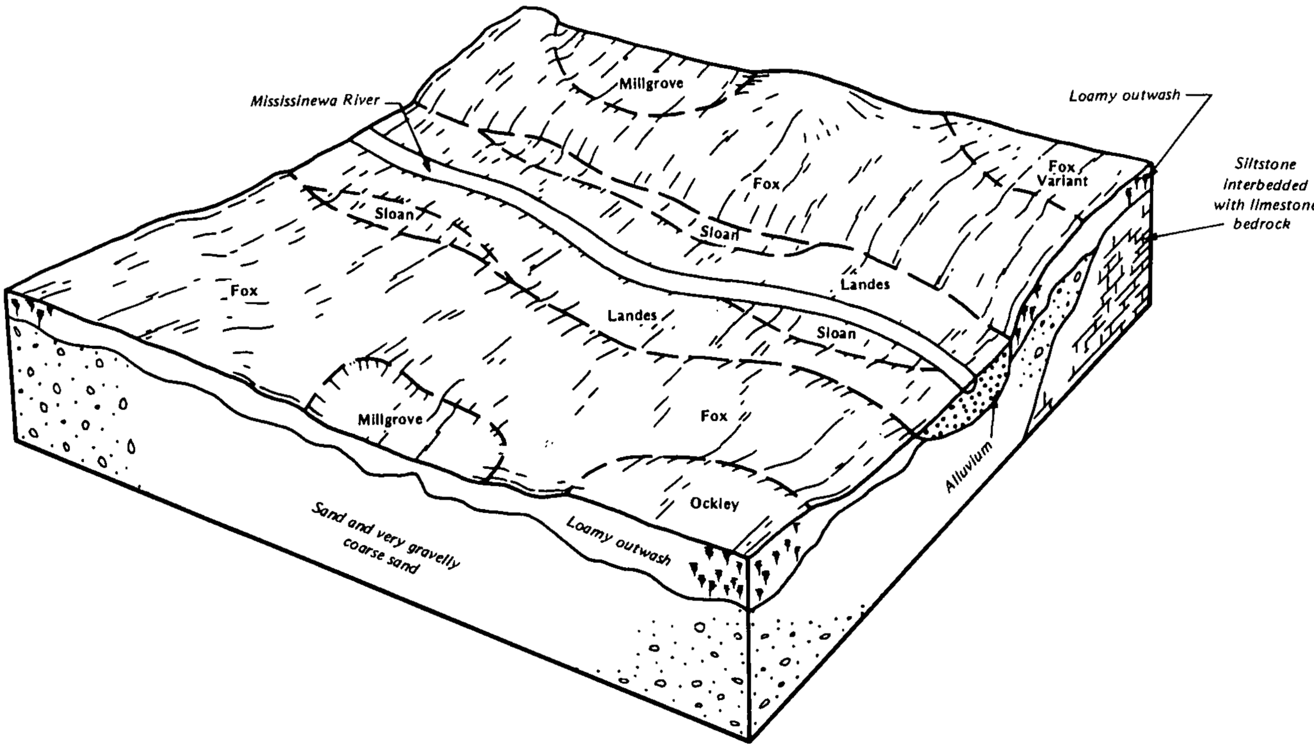

Figure 3.—Pattern of soils and parent material in the Fox-Landes map unit.

capacity. A few areas of this unit are mined for sand and gravel.

Nearly Level to Strongly Sloping Soils That Are Very Poorly Drained to Well Drained; on Uplands

These soils are on moraines and till plains. They make up about 41 percent of the county. Most areas are used for cultivated crops. Some areas of the moderately sloping and strongly sloping soils are used as woodland or pasture. Erosion and wetness are the main management concerns. Ponding is a hazard in depressions.

5. Glynwood-Morley-Pewamo

Deep, nearly level to strongly sloping, moderately well drained, well drained, poorly drained, and very poorly drained, medium textured and moderately fine textured soils formed in silty material over glacial till and in glacial till; on till plains and moraines

This map unit consists of soils on ridges and knolls and in broad depressions. Slopes range from 0 to 18 percent.

This map unit makes up about 5 percent of the county. It is about 44 percent Glynwood soils, 20 percent Morley soils, 12 percent Pewamo soils, and 24 percent minor soils.

The moderately well drained, gently sloping Glynwood soils are on ridges and knolls. Typically, they have a surface layer of brown silt loam and a subsoil of yellowish brown and dark yellowish brown, mottled silty clay loam and clay loam.

The well drained, moderately sloping and strongly sloping Morley soils are on ridges. Typically, they have a surface layer of dark grayish brown clay loam or dark grayish brown silt loam and a subsoil of dark yellowish brown and yellowish brown clay loam and clay.

The poorly drained and very poorly drained, nearly level Pewamo soils are in broad depressions. Typically, they have a surface layer of very dark gray silty clay loam and a subsoil of dark gray and gray, mottled silty clay loam and clay loam.

Minor in this map unit are the somewhat poorly drained Blount soils on slight rises, the well drained Fox soils in nearly level areas and on ridges and knolls on terraces, the well drained Hennepin soils on ridges along drainageways, the well drained and moderately well drained Landes soils on slight rises on flood plains, and the very poorly drained Sloan soils in depressions on flood plains.

Most areas are cultivated. The major soils are fairly well suited to cultivated crops, but the strongly sloping Morley soils are poorly suited. The main management concerns are erosion, slope, wetness, and ponding. Removing the plant cover from the Glynwood and Morley soils increases the susceptibility to erosion. The Pewamo soils are subject to ponding during periods of heavy precipitation.

The major soils are well suited to grasses and legumes for hay or pasture. The main management concerns are erosion, slope, wetness, and ponding. Overgrazing or grazing when the soils are wet causes surface compaction, excessive runoff, and poor tilth.

The major soils are fairly well suited to trees. The content of clay in the upper part of the soil profile, slope, wetness, and ponding are limitations.

The Glynwood and Morley soils are poorly suited to building site development and sanitary facilities because of wetness and slow or moderately slow permeability. The Pewamo soils are generally unsuitable for these uses because of ponding and moderately slow permeability.

6. Glynwood-Morley

Deep, gently sloping to strongly sloping, moderately well drained and well drained, fine textured to medium textured soils formed in silty material over glacial till and in glacial till; on till plains and moraines

This map unit consists of soils on ridges and knolls. Slopes range from 2 to 15 percent.

This map unit makes up about 8 percent of the county. It is about 69 percent Glynwood soils, 12 percent Morley soils, and 19 percent minor soils (fig. 4).

The moderately well drained, gently sloping Glynwood soils are on ridges and knolls. Typically, they have a surface layer of brown silty clay and a subsoil of yellowish brown and dark yellowish brown, mottled clay loam and clay.

The well drained, moderately sloping and strongly sloping Morley soils are on ridges. Typically, they have a surface layer of very dark grayish brown silt loam or dark grayish brown clay and a subsoil of dark yellowish brown clay loam and clay.

Minor in this map unit are the well drained Fox soils in nearly level areas and on ridges and knolls on terraces, the well drained Hennepin soils on ridges along drainageways, the poorly drained and very poorly drained Pewamo soils in broad depressional areas, and the very poorly drained Sloan soils on flood plains.

Most areas are cultivated. The major soils generally are fairly well suited to cultivated crops, but the severely eroded Morley soils are poorly suited. The main management concerns are erosion and slope. Removing the plant cover from these soils increases the susceptibility to erosion.

The major soils are well suited to grasses and legumes for hay or pasture. The main management concerns are erosion and slope. Overgrazing or grazing when the soils are wet causes surface compaction, excessive runoff, and poor tilth.

The major soils are fairly well suited to trees. The content of clay in the upper part of the soil profile and the slope are limitations.

In most areas the major soils are poorly suited to building site development and sanitary facilities because of wetness, slope, and slow permeability. The moderately sloping Morley soils, however, are suited to building site development.

7. Glynwood-Pewamo

Deep, gently sloping and nearly level, moderately well drained, poorly drained, and very poorly drained, fine textured and moderately fine textured soils formed in silty material over glacial till and in glacial till; on till plains and moraines

This map unit consists of soils on ridges and knolls and in broad depressional areas. Slopes range from 0 to 6 percent.

This map unit makes up about 16 percent of the county. It is about 54 percent Glynwood soils, 24 percent Pewamo soils, and 22 percent minor soils.

The moderately well drained, gently sloping Glynwood soils are on ridges and knolls. Typically, they have a surface layer of brown silty clay and a subsoil of yellowish brown and dark yellowish brown, mottled clay loam and clay.

The poorly drained and very poorly drained, nearly level Pewamo soils are in broad depressional areas. Typically, they have a surface layer of very dark gray silty clay loam and a subsoil of dark gray and gray, mottled silty clay loam and clay loam.

Minor in this map unit are the somewhat poorly drained Blount soils on slight rises; the very poorly drained Bono, Houghton, and Wallkill soils in depressions; the well drained Fox soils in nearly level areas, on ridges, and on knolls on terraces; the well drained Morley soils on ridges; and the very poorly drained Sloan soils in depressions on flood plains.

Most areas are cultivated. The major soils are fairly well suited to cultivated crops. Erosion, wetness, and ponding are the main management concerns. Removing the plant cover from the Glynwood soils increases the susceptibility to erosion. Pewamo soils are subject to ponding during periods of heavy precipitation.

The major soils are well suited to grasses and legumes for hay or pasture. Erosion, wetness, and ponding are the main management concerns. Overgrazing or grazing when the soils are wet causes surface compaction, excessive runoff, and poor tilth.

The major soils are fairly well suited to trees. The

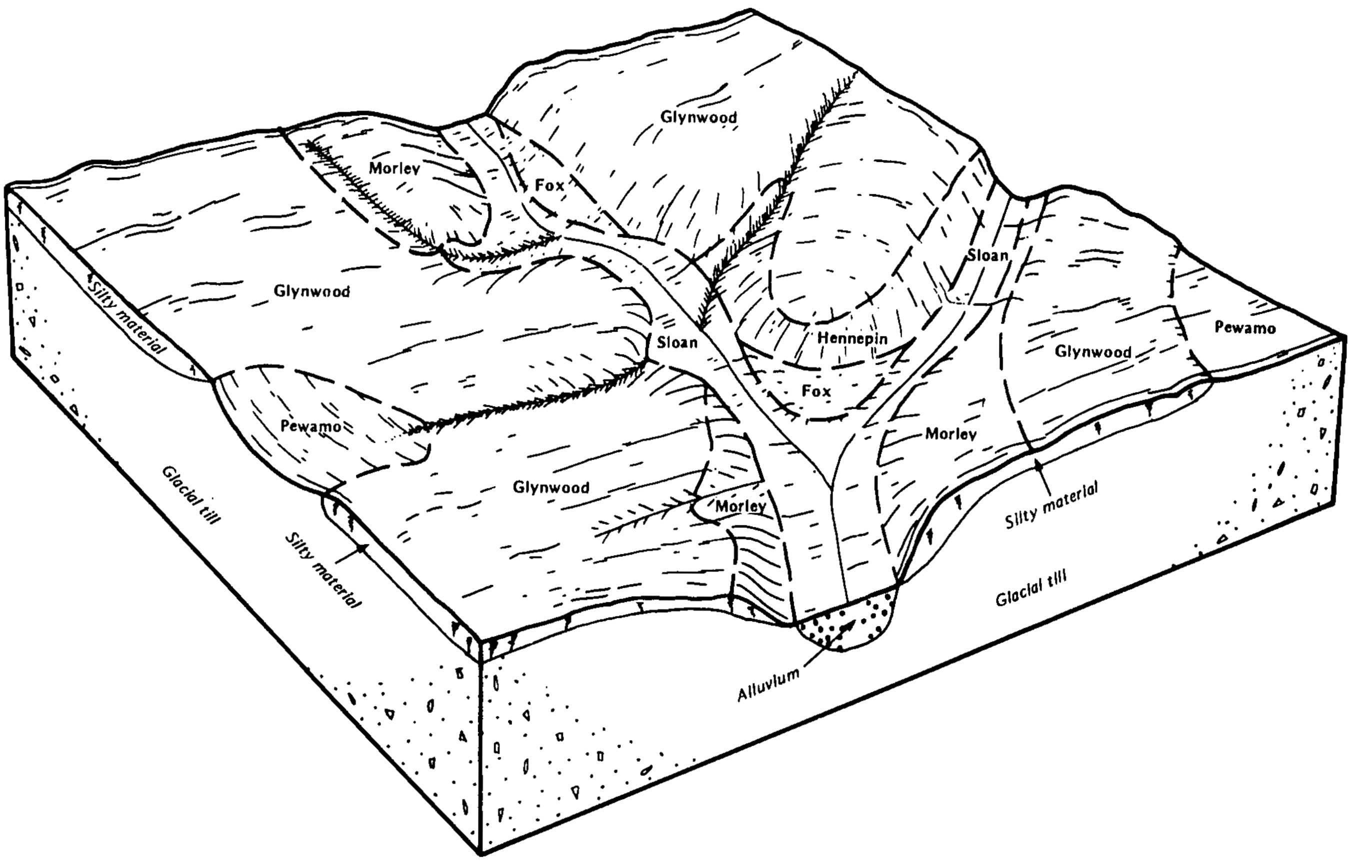

Figure 4.—Pattern of soils and parent material in the Glynwood-Morley map unit.

content of clay in the upper part of the soil profile and wetness are limitations.

The Glynwood soils are poorly suited to building site development and sanitary facilities because of wetness and slow permeability. The Pewamo soils are generally unsuitable for these uses because of ponding and moderately slow permeability.

8. Pewamo-Glynwood-Blount

Deep, nearly level and gently sloping, very poorly drained to moderately well drained, moderately fine textured and fine textured soils formed in glacial till and in silty material over glacial till; on till plains and moraines

This map unit consists of soils in broad depressional areas, on slight rises, and on ridges and knolls. Slopes range from 0 to 6 percent.

This map unit makes up about 12 percent of the county. It is about 49 percent Pewamo soils, 25 percent Glynwood soils, 21 percent Blount soils, and 5 percent minor soils (fig. 5).

The poorly drained and very poorly drained, nearly level Pewamo soils are in broad depressional areas. Typically, they have a surface layer of very dark gray silty clay loam and a subsoil of dark gray and gray, mottled silty clay loam and clay loam.

The moderately well drained, gently sloping Glynwood soils are on ridges and knolls. Typically, they have a surface layer of brown silty clay and a subsoil of yellowish brown and dark yellowish brown, mottled clay loam and clay.

The somewhat poorly drained, nearly level and gently sloping Blount soils are on slight rises. Typically, they have a surface layer of dark grayish brown silty clay loam and a subsoil of grayish brown, brown, and dark yellowish brown, mottled silty clay loam and silty clay.

Minor in this map unit are the very poorly drained Bono and Houghton soils in depressions.

Most areas are cultivated. The major soils are fairly well suited to cultivated crops. Ponding, wetness, and erosion are the main management concerns. The Pewamo soils are subject to ponding during periods of heavy precipitation. Removing the plant cover from the

Glynwood soils increases the susceptibility to erosion.

The major soils are well suited to grasses and legumes for hay or pasture. Ponding, wetness, and erosion are the main management concerns. Excessive runoff also is a concern on the Glynwood soils. Overgrazing or grazing when the soils are wet causes surface compaction and poor tilth.

The major soils are fairly well suited to trees. Wetness and the content of clay in the upper part of the soil profile are limitations.

The Glynwood and Blount soils are poorly suited to building site development and sanitary facilities because of wetness and moderately slow or slow permeability. The Pewamo soils are generally unsuitable for these uses because of ponding and moderately slow permeability.

Nearly Level Soils That Are Poorly Drained and Somewhat Poorly Drained; on Lake Plains and Till Plains

These soils are on broad lake plains and till plains. They make up about 2 percent of the county. Most areas are used for cultivated crops. Ponding and wetness are the main management concerns.

9. Patton-Crosby

Deep, nearly level, poorly drained and somewhat poorly drained, moderately fine textured and medium textured soils formed in silty material over lacustrine sediments and in silty material over glacial till; on lake plains and till plains

This map unit consists of soils in broad depressional areas and on slight rises. Slopes range from 0 to 2 percent.

This map unit makes up about 2 percent of the county. It is about 68 percent Patton soils, 23 percent Crosby soils, and 9 percent minor soils.

The poorly drained Patton soils are in broad depressional areas on lake plains. Typically, they have a surface layer of very dark gray silty clay loam and a subsoil of dark grayish brown and grayish brown, mottled silty clay loam.

The somewhat poorly drained Crosby soils are on slight rises on till plains. Typically, they have a surface layer of dark grayish brown silt loam and a subsoil of

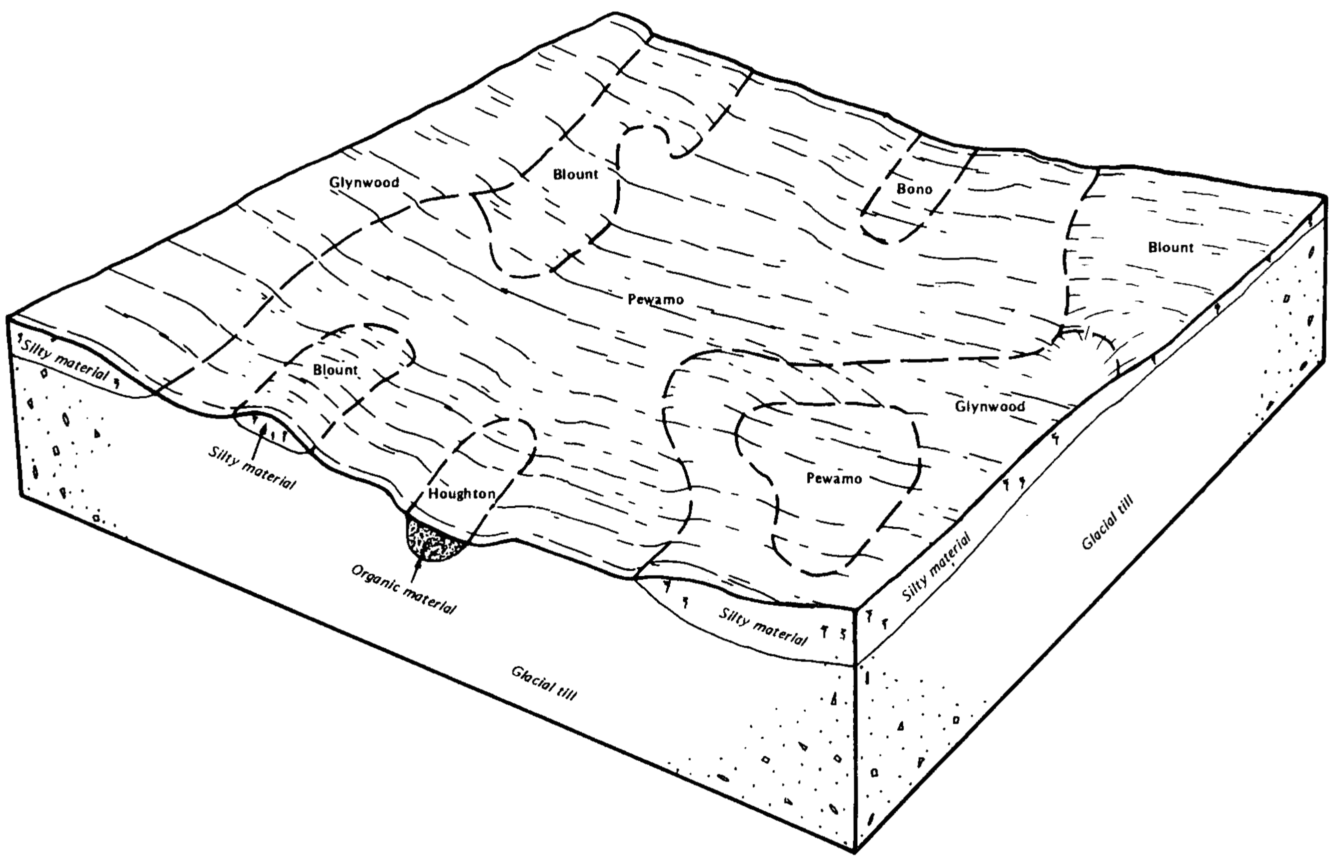

Figure 5.—Pattern of soils and parent material in the Pewamo-Glynwood-Blount map unit.

dark yellowish brown, mottled silty clay loam, clay loam, and loam.

Minor in this map unit are the moderately well drained Glynwood soils on ridges and knolls.

Most areas are cultivated. The major soils are well suited to cultivated crops. Ponding and wetness are the main management concerns.

The major soils are well suited to grasses and legumes for hay or pasture. Ponding and wetness are the main management concerns. Overgrazing or grazing when the soils are wet causes surface compaction and poor tilth.

The major soils are fairly well suited to trees. Wetness is a limitation.

The Crosby soils are poorly suited to building site development and sanitary facilities because of wetness and slow permeability. The Patton soils are generally unsuitable for these uses because of ponding and moderately slow permeability.

Broad Land Use Considerations

Most of the acreage in Grant County is used for cultivated crops. Most of the pasture in the county is in the Glynwood-Pewamo-Blount, Pewamo-Glynwood-Blount, Glynwood-Morley, and Glynwood-Pewamo map units. All of the general soil map units are well suited to pasture. Wetness and ponding are the main management concerns in the Pewamo-Blount, Pewamo-Glynwood, Pewamo-Glynwood-Blount, and Patton-Crosby map units. Erosion and droughtiness are the main management concerns in the Fox-Landes map unit, and erosion, slope, and wetness are the main management concerns in the Glynwood-Pewamo-Blount, Glynwood-Morley-Pewamo, Glynwood-Morley, and Glynwood-Pewamo map units.

The Fox-Landes map unit is well suited to woodland, and the rest of the map units are fairly well suited. Wetness and the content of clay in the upper part of the soil profile are the main management concerns in the Pewamo-Blount, Pewamo-Glynwood, and Pewamo-Glynwood-Blount map units. The content of clay in the upper part of the profile, the slope, and wetness are the main management concerns in the Glynwood-Morley-Pewamo, Glynwood-Morley, Glynwood-Pewamo, and Pewamo-Glynwood-Blount map units. Wetness is the main management concern in the Patton-Crosby map unit.

Deciding which land should be used for urban development is an important issue in the county. Each year part of the land near the larger towns and in scattered areas throughout the county is developed for urban uses. This expansion of urban areas removes prime agricultural land from production. The general soil map is most helpful in planning the general outline of urban areas, but it cannot be used for the selection of sites for specific urban structures. Most of the soils in the county that are well suited to cultivated crops are poorly suited to urban development.

The county has extensive areas where soil properties severely restrict or prohibit urban development. The Pewamo-Blount, Pewamo-Glynwood, Pewamo-Glynwood-Blount, and Patton-Crosby map units are severely limited by wetness and ponding. Any development on these soils is risky and costly. Extensive drainage systems and properly designed sanitary facilities and buildings would be needed. The Glynwood-Morley and Glynwood-Pewamo map units are poorly suited to urban uses because of wetness, ponding, and moderately slow or slow permeability. The Fox soils in the Fox-Landes map unit are fairly well suited to properly designed dwellings, but they are poorly suited to septic tank absorption fields because of a poor filtering capacity. The Landes soils are generally unsuitable for these uses because of flooding and a poor filtering capacity. Ockley soils, which are of minor extent in this map unit, have few limitations affecting urban development.

The Fox-Landes map unit is well suited to parks and other intensive recreational uses. The Glynwood-Pewamo-Blount, Glynwood-Morley-Pewamo, Glynwood-Morley, and Glynwood-Pewamo map units are suitable for these uses, but wetness, slope, and erosion are problems. The rest of the map units in the county are poorly suited to these uses, mainly because of wetness and ponding. A drainage system is somewhat effective in reducing the wetness.

All of the map units are well suited or fairly well suited to extensive recreational areas. They all provide some habitat for many important species of wildlife. Excellent sites for nature study areas are available in most of the map units. Undrained areas of poorly and very poorly drained soils provide excellent habitat for wetland wildlife.

Detailed Soil Map Units

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

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

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

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

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Morley clay, 6 to 15 percent slopes, severely eroded, is a phase of the Morley series.

Some map units are made up of two or more major soils. These map units are called soil complexes. 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. Urban land-Glynwood complex, 2 to 6 percent slopes, is an example.

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 is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

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

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

Soil Descriptions

BhA—Blount silt loam, 0 to 2 percent slopes. This nearly level, deep, somewhat poorly drained soil is on slight rises on till plains and moraines. Areas are irregularly shaped and are 3 to 30 acres in size.

In a typical profile, the surface layer is dark grayish brown silt loam about 9 inches thick. The subsoil is about 25 inches thick. It is mottled and firm. The upper part is dark yellowish brown silty clay loam, the next part is yellowish brown clay, and the lower part is brown clay loam. The underlying material to a depth of 60 inches is brown, calcareous clay loam. In some areas the silty material is thicker. In other areas the subsoil or the underlying material contains less clay. In some places the underlying material is stratified. In other places the soil is shallower or deeper to calcareous glacial till. In some areas bedrock is within a depth of 60 inches. In other areas the slope is more than 2 percent.

Included with this soil in mapping are areas of the moderately well drained Glynwood soils on ridges and knolls, the well drained Morley soils on ridges, and the poorly drained and very poorly drained Pewamo soils in broad depressions. Included soils make up 8 to 15 percent of the map unit.

The Blount soil has a moderate available water capacity. It is moderately slowly permeable in the subsoil and slowly permeable in the underlying material. The organic matter content is moderate in the surface layer. Runoff is slow. The water table is at a depth of 1 to 3 feet during winter and spring.

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

If drained, this soil is well suited to corn, soybeans, and small grain. Wetness is the main limitation. A subsurface drainage system helps to remove excess water. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface minimize crusting, improve tilth, and increase the organic matter content and the rate of water infiltration.

If drained, this soil is well suited to grasses and legumes, such as bromegrass and red clover, for hay or pasture. Because of the high water table, deep-rooted legumes, such as alfalfa, grow poorly in undrained areas. Overgrazing or grazing under wet conditions results in surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is fairly well suited to trees. The content of clay in the upper part of the soil is a limitation. Seedling mortality and the windthrow hazard are the main management concerns. Special planting stock and overstocking are needed. Special site preparation, such as bedding, is needed in some areas. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard.

Because of the wetness, this soil is severely limited as a site for dwellings. Installing subsurface drains and building the dwellings on raised, well compacted fill material help to overcome the wetness. The soil is severely limited as a site for local roads and streets because of low strength and frost action. The base material should be strengthened or replaced with material that can support vehicular traffic. Constructing the roads on raised, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by frost action.

This soil is severely limited as a site for septic tank absorption fields because of the wetness and the slow permeability. Perimeter subsurface drains help to lower the water table. Filling or mounding the absorption field with better suited material improves the capacity of the field to absorb the effluent.

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

BkB2—Blount silty clay loam, 1 to 3 percent slopes, eroded. This nearly level and gently sloping, deep, somewhat poorly drained soil is on slight rises on till plains and moraines. Areas are irregularly shaped and are 3 to 25 acres in size.

In a typical profile, the surface layer is dark grayish brown silty clay loam about 9 inches thick. It has some grayish brown silty clay from the subsoil. The subsoil is about 27 inches thick. It is mottled and firm. The upper part is grayish brown silty clay, the next part is brown and dark yellowish brown silty clay, and the lower part is dark yellowish brown silty clay loam. The underlying material to a depth of 60 inches is dark yellowish brown silty clay loam. In some places the subsoil, the underlying material, or both contain less clay. In other places the underlying material is stratified. In some areas the silty material is thicker. In other areas the surface layer has less clay. In places the slope is more than 3 percent.

Included with this soil in mapping are areas of the moderately well drained Glynwood soils on ridges and knolls, the well drained Morley soils on ridges, and the poorly drained and very poorly drained Pewamo soils in broad depressions. Included soils make up 2 to 10 percent of the map unit.

The Blount soil has a moderate available water capacity and is slowly permeable. The organic matter content is moderate in the surface layer. Runoff is slow. The water table is at a depth of 1 to 2 feet during winter and spring.

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

This soil is well suited to corn, soybeans, and small grain. Erosion is the major hazard, and the slow permeability and excess water are the main limitations. If cultivated crops are grown, measures that control erosion and runoff are needed. Examples are a cropping sequence that includes grasses and legumes, diversions, grassed waterways, and grade stabilization structures. A subsurface drainage system helps to remove excess water. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface minimize crusting, improve tilth, and increase the organic matter content and the rate of water infiltration.

If drained, this soil is well suited to grasses and legumes, such as bromegrass and red clover, for hay or pasture. Because of the high water table, deep-rooted legumes, such as alfalfa, grow poorly in undrained areas. Overgrazing or grazing under wet conditions results in surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is fairly well suited to trees. The content of clay in the upper part of the soil is a limitation. The main management concerns are seedling mortality, the windthrow hazard, and plant competition. Special planting stock and overstocking are needed. Special site preparation, such as bedding, is needed in some areas.

Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Special harvest methods and proper site preparation help to control plant competition.

Because of the wetness, this soil is severely limited as a site for dwellings. Installing subsurface drains and building the dwellings on raised, well compacted fill material help to overcome the wetness. The soil is severely limited as a site for local roads and streets because of low strength and frost action. The base material should be strengthened or replaced with material that can support vehicular traffic. Constructing the roads on raised, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by frost action.

This soil is severely limited as a site for septic tank absorption fields because of the wetness and the slow permeability. Perimeter subsurface drains help to lower the water table. Filling or mounding the absorption field with better suited material improves the capacity of the field to absorb the effluent.

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

Bn—Bono silty clay. This nearly level, deep, very poorly drained soil is in depressions on glacial lake plains. It is frequently ponded by runoff from the higher adjacent areas. Areas are irregularly shaped and are 3 to 15 acres in size.

In a typical profile, the surface layer is black silty clay about 11 inches thick. The subsoil is about 44 inches thick. It is mottled. In sequence downward, it is dark gray, very firm silty clay; gray, firm silty clay; gray, firm clay that has thin strata of clay loam; and gray, firm silty clay loam that has thin strata of clay loam. The underlying material to a depth of 60 inches is gray, mottled silty clay loam that has thin strata of clay loam and sandy loam. In some areas the silty material is thicker. In other areas the dark surface layer is less than 10 inches thick. In some places the surface layer is lighter colored. In other places it contains more clay. In some areas it is a thin layer of muck. In other areas the subsoil, the underlying material, or both contain less clay. In some places calcareous glacial till is within a depth of 60 inches. In other places the soil is underlain by organic deposits.

Included with this soil in mapping are areas of the very poorly drained Houghton and Wallkill soils in depressions and the somewhat poorly drained Blount soils on slight rises. Houghton soils formed in thick organic deposits, and Wallkill soils are underlain by organic material. Also included are some areas that have not been drained and that remain wet most of the year. Included soils make up 5 to 10 percent of the map unit.

The Bono soil has a moderate available water capacity and is slowly permeable. The organic matter content is high in the surface layer. Runoff is very slow or ponded. The water table is near or above the surface during winter and spring.

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

If drained, this soil is fairly well suited to corn, soybeans, and small grain. The wetness and the ponding are the main management concerns. They can hinder the use of farm equipment. Shallow surface drains and subsurface drains can remove excess water. In some areas, however, adequate outlets are difficult to locate. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface minimize crusting, improve tilth, and increase the organic matter content and the rate of water infiltration. The soil is well suited to fall plowing.

This soil is well suited to grasses, such as reed canarygrass, for pasture. In undrained areas, it is poorly suited to deep-rooted legumes, such as alfalfa, because of the high water table. Even if subsurface and shallow surface drains are installed, legumes are damaged by the ponding. Overgrazing or grazing under wet conditions results in surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to trees. The wetness is a limitation. The equipment limitation, seedling mortality, and plant competition are the main management concerns. Equipment should be used only when the soil is relatively dry or frozen. Special planting stock and overstocking are needed. Special site preparation, such as bedding, is needed in some areas. Special harvest methods and proper site preparation help to control plant competition.

This soil is generally unsuitable as a site for dwellings because of the ponding and the shrink-swell potential and as a site for sanitary facilities because of the ponding and the slow permeability. It is severely limited as a site for local roads and streets because of the ponding, the shrink-swell potential, and low strength. Constructing the roads on raised, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by ponding. The base material should be strengthened or replaced with material that can support vehicular traffic.

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

CuA—Crosby silt loam, 0 to 2 percent slopes. This nearly level, deep, somewhat poorly drained soil is on slight rises on till plains. Areas are irregularly shaped and are 3 to 30 acres in size.

In a typical profile, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil is about 27 inches of dark yellowish brown, mottled, firm silty clay loam, clay loam, and loam. The underlying material to a depth of 60 inches is brown loam. In some areas the deposit of silty material is thicker. In other areas the surface layer has more clay. In some places the subsoil is browner or has less clay, or both. In other places the underlying material has more clay. In some areas it is stratified. In other areas the soil is shallower or deeper to calcareous glacial till. In places the slope is more than 2 percent.

Included with this soil in mapping are areas of the poorly drained Patton soils in broad depressions. These soils make up 5 to 10 percent of the map unit.

The Crosby soil has a high available water capacity and is slowly permeable. The organic matter content is moderate in the surface layer. Runoff is slow. The water table is at a depth of 1 to 3 feet during winter and spring.

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

If drained, this soil is well suited to corn, soybeans, and small grain. Wetness is the main limitation. A subsurface drainage system helps to remove excess water. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface minimize crusting, improve tilth, and maintain or increase the organic matter content and the rate of water infiltration.

If drained, this soil is well suited to grasses and legumes, such as bromegrass and red clover, for hay or pasture. Because of the high water table, deep-rooted legumes, such as alfalfa, grow poorly in undrained areas. Overgrazing or grazing under wet conditions results in surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. It can be controlled by special harvest methods and by proper site preparation.

Because of the wetness, this soil is severely limited as a site for dwellings. Installing subsurface drains and building the dwellings on raised, well compacted fill material help to overcome the wetness. The soil is severely limited as a site for local roads and streets because of low strength and frost action. The base material should be strengthened or replaced with material that can support vehicular traffic. Constructing the roads on raised, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by frost action.

This soil is severely limited as a site for septic tank absorption fields because of the wetness and the slow permeability. Perimeter subsurface drains help to lower the water table. Filling or mounding the absorption field with better suited material improves the capacity of the field to absorb the effluent.

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

FsA—Fox silt loam, 0 to 2 percent slopes. This nearly level, well drained soil is on terraces. It is moderately deep over sand and very gravelly coarse sand. Areas are elongated and are 20 to 50 acres in size.

In a typical profile, the surface layer is brown silt loam about 9 inches thick. The subsoil is about 26 inches thick. The upper part is dark yellowish brown, friable clay loam, and the lower part is brown and dark reddish brown, friable gravelly sandy clay loam. The underlying material to a depth of 60 inches is yellowish brown very gravelly coarse sand. In some areas the silty material is thicker. In other areas the surface layer is gravelly or cobbly. In some places the subsoil contains less clay. In other places the subsoil, the underlying material, or both contain more clay. In some areas the soil is shallower to calcareous sand and very gravelly coarse sand. In other areas it is grayer. In some places calcareous glacial till is within a depth of 60 inches. In other places the slope is more than 2 percent.

Included with this soil in mapping are the well drained Fox Variant and Ockley soils and the very poorly drained Millgrove soils. Fox Variant and Ockley soils are in nearly level areas or on ridges and knolls. Fox Variant soils are underlain by bedrock, and Ockley soils are deeper to sand and very gravelly coarse sand than the Fox soil. Millgrove soils are in depressions. Included soils make up 8 to 15 percent of the map unit.

The Fox soil has a moderate available water capacity. Permeability is moderate in the subsoil and rapid or very rapid in the underlying material. The organic matter content is moderate in the surface layer. Runoff is slow.

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

This soil is well suited to corn, soybeans, and small grain. Drought is the main hazard. Cobbles at or near the surface hinder fieldwork. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface conserve moisture, minimize crusting, improve tilth, and increase the organic matter content and the rate of water infiltration. The soil is well suited to no-till planting.

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

This soil is well suited to trees. Plant competition is moderate. It can be controlled by special harvest methods and by proper site preparation.

This soil is suited to dwellings with basements. It is moderately limited as a site for dwellings without basements because of the shrink-swell potential. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling.

Because of frost action and the shrink-swell potential, this soil is moderately limited as a site for local roads and streets. Constructing the roads on raised, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by frost action. Strengthening or replacing the base with better suited material improves the ability of the roads and streets to support vehicular traffic.

This soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water supplies.

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

FsB2—Fox silt loam, 2 to 6 percent slopes, eroded. This gently sloping, well drained soil is on ridges and knolls on terraces. It is moderately deep over sand and very gravelly coarse sand. Areas are irregularly shaped or elongated and are 3 to 30 acres in size.

In a typical profile, the surface layer is brown silt loam about 7 inches thick. About 15 percent of this layer is dark yellowish brown subsoil material. The subsoil is about 23 inches thick. The upper part is dark yellowish brown, firm clay loam; the next part is brown, firm and friable gravelly sandy clay loam; and the lower part is dark reddish brown, friable gravelly sandy clay loam. The underlying material to a depth of 60 inches is yellowish brown very gravelly coarse sand. In some areas the silty material is thicker. In other areas the surface layer is gravelly or cobbly. In some places it contains more clay. In other places the subsoil contains less clay. In some areas the subsoil, the underlying material, or both contain more clay. In other areas the soil is shallower to calcareous sand and very gravelly coarse sand. In some places calcareous glacial till is within a depth of 60 inches. In other places the subsoil is grayer. In some areas the slope is less than 2 or more than 6 percent.

Included with this soil in mapping are the well drained Fox Variant soils in nearly level areas and on ridges and knolls, the well drained Ockley soils in nearly level areas, and the very poorly drained Millgrove soils in depressions. Fox Variant soils are underlain by bedrock. Ockley soils are deeper to sand and very gravelly coarse sand than the Fox soil. Also included are some areas where bedrock is exposed. Included areas make up 5 to 15 percent of the map unit.

The Fox soil has a moderate available water capacity. Permeability is moderate in the subsoil and rapid or very rapid in the underlying material. The organic matter content is moderate in the surface layer. Runoff is medium.

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

This soil is well suited to corn, soybeans, and small grain. If cultivated crops are grown, measures that control erosion and runoff are needed. Examples are a cropping sequence that includes grasses and legumes, conservation tillage, diversions, grassed waterways, and grade stabilization structures. Droughtiness is a limitation. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface conserve moisture, minimize crusting, improve tilth, and increase the organic matter content and the rate of water infiltration. The soil is well suited to no-till planting.

This soil is well suited to grasses and legumes, such as bromegrass and alfalfa, for hay or pasture. Erosion is the main hazard. Overgrazing or grazing under wet conditions results in surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is the main management concern. It can be controlled by special harvest methods and by proper site preparation.

This soil is suited to dwellings with basements. It is moderately limited as a site for dwellings without basements because of the shrink-swell potential. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. Retaining as much of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion.

Because of frost action and the shrink-swell potential, this soil is moderately limited as a site for local roads and streets. Constructing the roads on raised, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by frost action. The base material should be strengthened or replaced with material that can support vehicular traffic.

This soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water supplies.

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

FtC3—Fox clay loam, 6 to 15 percent slopes, severely eroded. This moderately sloping and strongly sloping, well drained soil is on ridges on terraces. It is moderately deep over sand and very gravelly coarse sand. Areas are elongated and are 3 to 10 acres in size.

In a typical profile, the surface layer is brown clay loam about 7 inches thick. In most areas, part of the original darkened surface layer has been removed by erosion and tillage has mixed the rest with the upper part of the subsoil. The subsoil is about 18 inches thick. The upper part is brown, firm clay loam; the next part is brown, friable gravelly sandy clay loam; and the lower part is dark reddish brown, friable gravelly sandy clay loam. The underlying material to a depth of 60 inches is yellowish brown very gravelly coarse sand. In some places the surface layer contains less clay. In other areas it is gravelly or cobbly. In some areas the subsoil contains less clay. In other areas the subsoil, the underlying material, or both contain more clay. In places the soil is shallower to calcareous sand and very gravelly coarse sand. In a few places calcareous glacial till is within a depth of 60 inches. In some areas the slope is less than 6 or more than 15 percent.

Included with this soil in mapping are the well drained Fox Variant soils in nearly level areas and on ridges and knolls, the well drained Ockley soils in nearly level areas, and the very poorly drained Millgrove soils in depressions. Fox Variant soils are underlain by bedrock. Ockley soils are deeper to sand and very gravelly coarse sand than the Fox soil. Also included are some areas where bedrock is exposed. Included areas make up 5 to 15 percent of the map unit.

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

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

This soil is poorly suited to corn, soybeans, and small grain. Erosion is the main hazard. Drought also is a hazard. If cultivated crops are grown, measures that control erosion and runoff are needed. Examples are a cropping sequence that includes grasses and legumes, a system of conservation tillage that leaves protective amounts of crop residue on the surface, diversions, grassed waterways, and grade stabilization structures. Cover crops and conservation tillage conserve moisture, minimize crusting, improve tilth, and increase the organic matter content and the rate of water infiltration. The soil is well suited to no-till planting.

This soil is fairly well suited to grasses and legumes, such as bromegrass and alfalfa, for hay and is well suited to pasture. Erosion is the main hazard. Overgrazing or grazing under wet conditions results in surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. It can be controlled by special harvest methods and by proper site preparation.

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

Because of the slope, the potential for frost action, and the shrink-swell potential, this soil is moderately limited as a site for local roads and streets. Cutting and filling and building the roads on the contour help to overcome the slope. Constructing the roads on raised, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by frost action. Strengthening or replacing the base with better suited material improves the ability of the roads and streets to support vehicular traffic.

This soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water supplies.

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

FvB—Fox Variant silt loam, 1 to 4 percent slopes. This nearly level and gently sloping, moderately deep, well drained soil is in plane areas and on ridges and knolls on terraces. Areas are irregularly shaped and are 5 to 15 acres in size.

In a typical profile, the surface layer is brown silt loam about 9 inches thick. The subsurface layer is brown, friable silt loam about 4 inches thick. The subsoil is about 12 inches thick. It is brown and firm. The upper part is clay loam, and the lower part is gravelly clay loam. Below this is siltstone interbedded with limestone. In some areas the silty material is thicker. In other areas the surface layer has more clay. In some places it is gravelly or cobbly. In other places the subsoil has more clay or less clay. In some areas the soil is shallower over bedrock. In other areas the subsoil is grayer. In places the slope is less than 1 or more than 4 percent.

Included with this soil in mapping are the well drained Fox soils in nearly level areas and on ridges and knolls and the very poorly drained Millgrove soils in depressions. Fox soils are underlain by sand and very gravelly coarse sand. Also included are areas where bedrock is exposed. Included areas make up 5 to 10 percent of the map unit.

The Fox Variant soil has a low available water capacity and is moderately permeable. The organic matter content is moderate in the surface layer. Runoff is slow or medium.

Most areas of this soil are used for cultivated crops. Some are woodland or idle land.

This soil is well suited to corn, soybeans, and small grain. Erosion is the main hazard. Drought also is a hazard. If cultivated crops are grown, measures that control erosion and runoff are needed. Examples are a cropping sequence that includes grasses and legumes, a system of conservation tillage that leaves protective amounts of crop residue on the surface, grassed waterways, and grade stabilization structures. Cover crops and conservation tillage conserve moisture, minimize crusting, improve tilth, and increase the organic matter content and the rate of water infiltration. The soil is well suited to no-till planting.

This soil is well suited to grasses and legumes, such as bromegrass and alfalfa, for hay or pasture. Erosion is the main hazard. Overgrazing or grazing under wet conditions results in surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition and the windthrow hazard are the main management concerns. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Special harvest methods and proper site preparation help to control plant competition.

Because of the shrink-swell potential and the depth to bedrock, this soil is moderately limited as a site for dwellings without basements. It is severely limited as a site for dwellings with basements and as a site for septic tank absorption fields because of the depth to bedrock. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the damage to buildings caused by shrinking and swelling. Measures that overcome the depth to bedrock are quite expensive. Retaining as much of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion.

Because of the depth to bedrock, the potential for frost action, and the shrink-swell potential, this soil is moderately limited as a site for local roads and streets. Measures that overcome the depth to bedrock are quite expensive. Constructing the roads on raised, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by frost action. Strengthening or replacing the base with better suited material improves the ability of the roads and streets to support vehicular traffic.

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

GrB2—Glynwood silt loam, 2 to 6 percent slopes, eroded. This gently sloping, deep, moderately well drained soil is on ridges and knolls on till plains and moraines. Areas are irregularly shaped and are 3 to 35 acres in size.

In a typical profile, the surface layer is brown silt loam about 8 inches thick. About 20 percent of this layer is yellowish brown subsoil material. The subsoil is about 23 inches thick. It is mottled and firm. The upper part is yellowish brown silty clay loam, and the lower part is dark yellowish brown clay loam. The underlying material to a depth of 60 inches is yellowish brown clay loam. In some areas the surface layer is thicker. In other areas it is less than 6 inches thick. In some places the surface layer, the subsoil, or the underlying material contains less clay. In other places the underlying material is stratified. In some areas the soil is deeper to calcareous glacial till. In other areas the slope is less than 2 or more than 6 percent.

Included with this soil in mapping are areas of the somewhat poorly drained Blount soils on slight rises, the well drained Hennepin soils on ridges along drainageways, the well drained Morley soils on ridges, and the poorly drained and very poorly drained Pewamo soils in broad depressions. Included soils make up 2 to 12 percent of the map unit.

The Glynwood soil has a moderate available water capacity and is slowly permeable. The organic matter content is moderate in the surface layer. Runoff is medium. The water table is at a depth of 2.0 to 3.5 feet in winter and spring.

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

This soil is fairly well suited to corn, soybeans, and small grain. If cultivated crops are grown, measures that control erosion and runoff are needed. Examples are a cropping sequence that includes grasses and legumes, a system of conservation tillage that leaves protective amounts of crop residue on the surface, grassed waterways, and grade stabilization structures. Cover crops and conservation tillage minimize crusting, improve tilth, and increase the organic matter content and the rate of water infiltration.

This soil is well suited to grasses and legumes, such as bromegrass and alfalfa, for hay or pasture. Erosion is the main hazard. Overgrazing or grazing under wet conditions results in surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. The content of clay in the upper part of the soil is a limitation. Seedling mortality, the windthrow hazard, and plant competition are the main management concerns. Special planting stock and overstocking are needed. Special site preparation, such as bedding, is needed in some areas. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Special harvest methods and proper site preparation help to control plant competition.

Because of the wetness and the shrink-swell potential, this soil is moderately limited as a site for dwellings without basements. It is severely limited as a site for dwellings with basements because of the wetness. Building the dwellings on raised, well compacted fill material helps to overcome the wetness. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. Retaining as much of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion.

This soil is severely limited as a site for local roads and streets because of low strength and frost action. The base material should be strengthened or replaced with material that can support vehicular traffic. Constructing the roads on raised, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by frost action.

Because of the wetness and the slow permeability, this soil is severely limited as a site for septic tank absorption fields. Perimeter subsurface drains lower the water table. Filling or mounding the absorption field with better suited material improves the capacity of the field to absorb the effluent.

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

GsB3—Glynwood silty clay, 2 to 6 percent slopes, severely eroded. This gently sloping, deep, moderately well drained soil is on ridges and knolls on till plains and moraines. Areas are irregularly shaped and are 3 to 45 acres in size.

In a typical profile, the surface layer is brown silty clay about 9 inches thick. In most areas, part of the original darkened surface layer has been removed by erosion and tillage has mixed the rest with the upper part of the subsoil. The subsoil is about 18 inches of yellowish brown and dark yellowish brown, mottled, firm clay and clay loam. The underlying material to a depth of 60 inches is dark yellowish brown clay loam. In some places the surface layer has less clay. In other places the subsoil, the underlying material, or both have less clay. In some areas the underlying material is stratified. In other areas the soil is deeper to calcareous glacial till. In a few places the slope is less than 2 or more than 6 percent.

Included with this soil in mapping are areas of the well drained Hennepin and Morley soils on ridges along drainageways, the very poorly drained Pewamo soils in broad depressions, and the somewhat poorly drained Blount soils on slight rises. Included soils make up 5 to 15 percent of the map unit.

The Glynwood soil has a moderate available water capacity and is slowly permeable. The organic matter content is low in the surface layer. Runoff is medium. The water table is at a depth of 2.0 to 3.5 feet during the spring. The surface layer tends to crust or puddle after heavy rains.

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

This soil is fairly well suited to corn, soybeans, and small grain. Erosion is the main hazard. If cultivated crops are grown, measures that control erosion and runoff are needed. Examples are a cropping sequence that includes grasses and legumes, a system of conservation tillage that leaves protective amounts of crop residue on the surface (fig. 6), grassed waterways, and grade stabilization structures. Cover crops and conservation tillage minimize crusting, improve tilth, and increase the organic matter content and the rate of water infiltration.

This soil is well suited to grasses and legumes, such as bromegrass and alfalfa, for hay or pasture. Erosion is the main hazard. Overgrazing or grazing under wet conditions results in surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. The content of clay in the upper part of the soil is a limitation. The main management concerns are seedling mortality, the windthrow hazard, and plant competition. Special planting stock and overstocking are needed. Special site preparation, such as bedding, is needed in some areas. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Special harvest methods and proper site preparation help to control plant competition.

Because of the wetness and the shrink-swell potential, this soil is moderately limited as a site for dwellings without basements. It is severely limited as a site for dwellings with basements because of the wetness. Building the dwellings on raised, well compacted fill material helps to overcome the wetness. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. Retaining as much of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion.

Because of the shrink-swell potential and low strength, this soil is severely limited as a site for local roads and streets. Strengthening or replacing the base with better suited material improves the ability of the roads and streets to support vehicular traffic. Constructing the roads on raised, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by frost action.

Because of the wetness and the slow permeability, this soil is severely limited as a site for septic tank absorption fields. Perimeter subsurface drains lower the water table. Filling or mounding the absorption field with better suited material improves the capacity of the field to absorb the effluent.

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

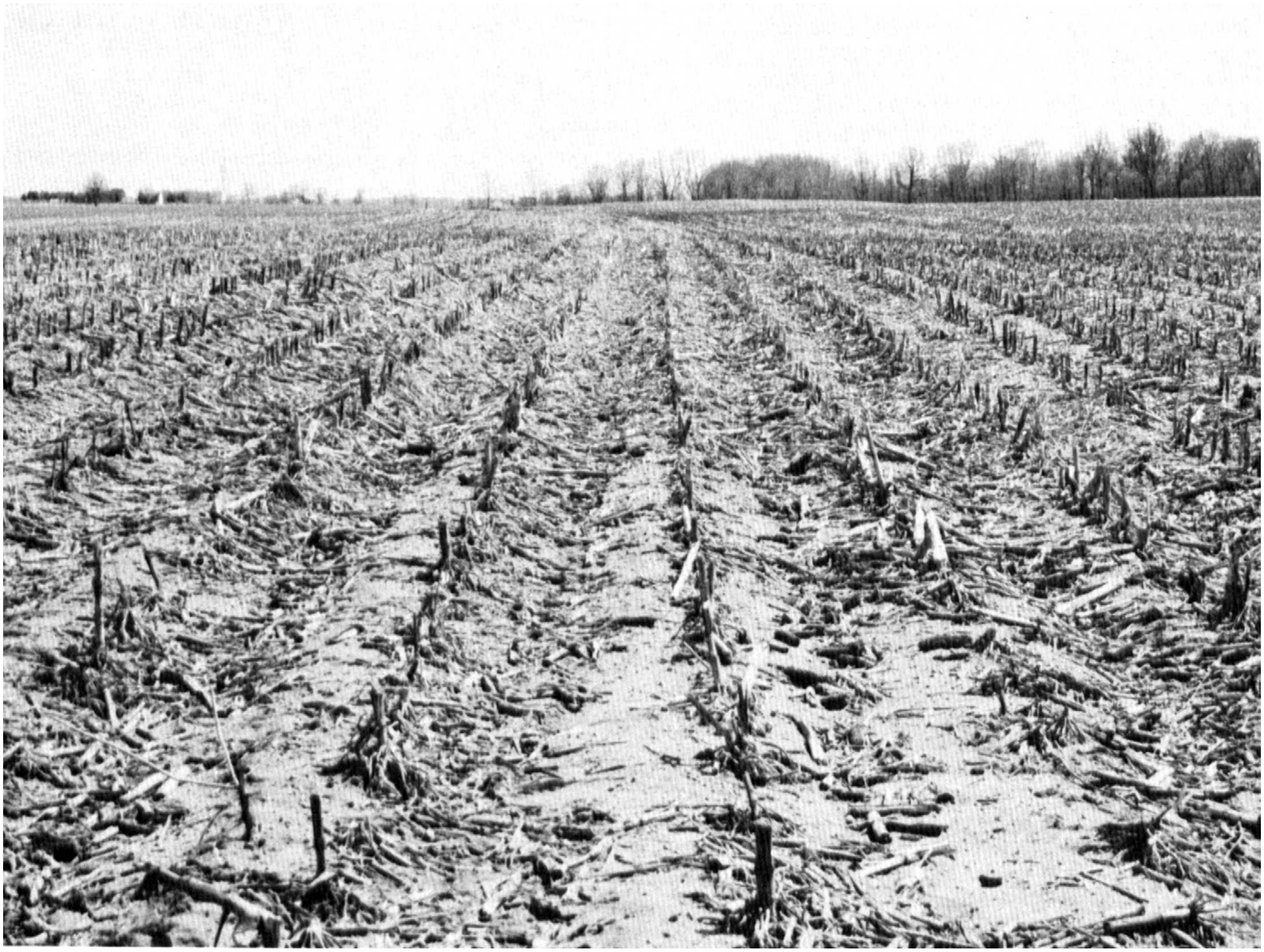

Figure 6.—Ridge tillage in an area of Glynwood silty clay, 2 to 6 percent slopes, severely eroded.

HeG—Hennepin clay loam, 30 to 70 percent slopes. This steep and very steep, deep, well drained soil is on the ridges along drainageways on till plains and moraines. Areas are elongated and are 8 to 25 acres in size.

In a typical profile, the surface layer is very dark grayish brown clay loam about 3 inches thick. The subsoil is yellowish brown, firm clay loam about 10 inches thick. The underlying material to a depth of 60 inches is brown clay loam. In some places the soil has less clay throughout. In other places the underlying material is stratified. In some areas bedrock is within a depth of 60 inches. In other areas the soil is deeper to calcareous glacial till. In places the slope is less than 30 or more than 70 percent.

Included with this soil in mapping are areas of the moderately well drained Glynwood soils on ridges and knolls and the well drained Morley soils on ridges. Both of these soils have more clay in the subsoil than the Hennepin soil. Also included are some areas where bedrock is exposed. Included areas make up 5 to 15 percent of the map unit.

The Hennepin soil has a moderate available water capacity. Permeability is moderately slow in the subsoil and moderately slow or slow in the underlying material. The organic matter content is moderately low in the surface layer. Runoff is very rapid.

Most areas of this soil are wooded (fig. 7). A few are used for pasture.

This soil is generally unsuited to cultivated crops and to grasses and legumes for hay. It is poorly suited to pasture. Erosion is the main hazard. The slope is a limitation. It restricts the use of standard farm equipment.

This soil is poorly suited to trees. The slope is a limitation. The main management concerns are the erosion hazard, the equipment limitation, and plant competition. Locating logging roads, skid trails, and landings on gentle grades and removing water with water bars, out-sloping road surfaces, culverts, and drop structures help to control erosion. Operating ordinary crawler tractors and rubber-tired skidders is hazardous because of the slope. Special logging methods, such as yarding the logs uphill with a cable, may be necessary. Special harvest methods and proper site preparation help to control plant competition.

This soil is generally unsuitable as a site for dwellings and local roads because of the slope and as a site for sanitary facilities because of the slope and the moderately slow or slow permeability. A suitable alternative site should be selected.

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

Ht—Houghton muck, drained. This nearly level, deep, very poorly drained soil is in depressions on glacial lake plains. It is frequently ponded by runoff from the higher adjacent areas. Areas are irregularly shaped or circular and are 3 to 40 acres in size.

Figure 7.—A wooded area of Hennepin clay loam, 30 to 70 percent slopes.

In a typical profile, the surface layer is black muck about 9 inches thick. Below this to a depth of 60 inches is black and dark reddish brown, friable muck that has some partially decomposed fibrous fragments. In places the organic deposit is less than 60 inches thick. In some areas 10 to 16 inches of mineral sediments overlies the organic deposit.

Included with this soil in mapping are areas of the very poorly drained Wallkill and Bono and poorly drained and very poorly drained Pewamo soils in depressions. Bono and Pewamo are deep, mineral soils. Wallkill soils have mineral sediments more than 16 inches deep over organic deposits. Also included are some areas where sedimentary peat or mineral material is at a depth of 20 to 60 inches and some areas that have not been drained and remain wet most of the year. Included soils make up 5 to 15 percent of the map unit.

The Houghton soil has a very high available water capacity. Permeability is moderately slow to moderately rapid. The organic matter content is very high in the surface layer. Runoff is very slow or ponded. The water table is near or above the surface in fall, winter, and spring. The surface layer is friable and can be easily tilled.

Most areas of this soil are drained and are used for cultivated crops. Some are used for hay or pasture. Some undrained areas support a natural cover of mixed hardwoods or wetland shrubs and grasses.

If drained, this soil is well suited to corn and soybeans. The wetness is the main limitation, and the ponding is a hazard. Open ditches, pumps, and a combination of subsurface drains and adequate outlets can remove excess water. Excessive drainage can result in accelerated subsidence of the muck. Raising the water table during fallow periods slows the rate of subsidence. Soil blowing is a hazard. It can be controlled by cover crops, by a system of conservation tillage that leaves protective amounts of crop residue on the surface, and by various types of windbreaks. The use of heavy equipment is restricted because the soil is very unstable.

Because of the high water table, this soil is generally unsuited to deep-rooted legumes, such as alfalfa, and is poorly suited to most grasses for hay or pasture. It is well suited to reed canarygrass. The wetness is the main limitation, and the ponding is a hazard. A cover of grasses is effective in controlling soil blowing. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is poorly suited to trees. The wetness is a limitation. The equipment limitation, seedling mortality, the windthrow hazard, and plant competition are management concerns. Equipment should be used only when the ground is frozen. Special planting stock and overstocking are needed. Special site preparation, such as bedding, is needed in some areas. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Special harvest methods and proper site preparation help to control plant competition.

Because of the ponding, this soil is generally unsuitable as a site for dwellings, local roads, and sanitary facilities. A suitable alternative should be selected.

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

Lc—Landes sandy loam, occasionally flooded. This nearly level, deep, well drained and moderately well drained soil is on slight rises on flood plains. It is occasionally flooded for brief periods in winter and spring (fig. 8). Areas are elongated and are 10 to more than 50 acres in size.

In a typical profile, the surface layer is very dark grayish brown sandy loam about 8 inches thick. The subsurface layer also is very dark grayish brown sandy loam. It is about 6 inches thick. The subsoil is dark yellowish brown and brown, friable sandy loam about 16 inches thick. The upper part of the underlying material is brown and dark yellowish brown sandy loam. The lower part to a depth of 60 inches is brown loamy sand. In some areas the surface layer is lighter colored. In other areas it is less than 10 inches thick. In some places it is gravelly. In other places it contains less clay or more clay. In some areas the subsoil contains less clay. In other areas the subsoil, the underlying material, or both contain more clay. In some places the soil is underlain by calcareous sand and gravelly sand. In other places calcareous glacial till or bedrock is within a depth of 60 inches.

Included with this soil in mapping are areas of the very poorly drained Sloan soils in depressions. Also included are some areas where the soil is frequently flooded for long periods and areas where bedrock is exposed. Included areas make up 5 to 10 percent of the map unit.

The Landes soil has a moderate available water capacity and is moderately rapidly permeable or rapidly permeable. The organic matter content is moderately low in the surface layer. Runoff is slow. The water table is at a depth of 4 to 6 feet during spring.

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

This soil is well suited to corn, soybeans, and small grain. The flooding is the main hazard. Drought also is a hazard. Planting late in the spring or replanting is sometimes needed because of the flooding. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface conserve moisture, minimize crusting, improve tilth, and increase the organic matter content and the rate of water infiltration.

This soil is well suited to grasses and legumes, such as bromegrass and alfalfa, for hay or pasture. The flooding is the main hazard. Overgrazing or grazing

Figure 8.—An area of Landes sandy loam, occasionally flooded, along the Mississinewa River after a heavy rain.

under wet conditions results in surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is the main management concern. It can be controlled by special harvest methods and by proper site preparation.

Because of the flooding, this soil is generally unsuitable as a site for dwellings. It also is generally unsuitable as a site for sanitary facilities because of the flooding and a poor filtering capacity. A suitable alternative site should be selected. The soil is severely limited as a site for local roads and streets because of the flooding. Constructing the roads on raised, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by floodwater.

The land capability classification is IIw. The woodland ordination symbol is 7A.

Mg—Millgrove loam. This nearly level, deep, very poorly drained soil is in depressions on terraces. It is frequently ponded by runoff from the higher adjacent areas. Areas are irregularly shaped and are 5 to 20 acres in size.

In a typical profile, the surface layer is very dark gray loam about 11 inches thick. The subsoil is about 30 inches thick. The upper part is dark gray, mottled, friable loam and firm clay loam; the next part is gray, mottled, firm clay loam and gravelly clay loam; and the lower part is dark gray, mottled, friable sandy loam. The upper part of the underlying material is dark gray, mottled sandy loam and gravelly sandy loam. It has thin strata of loamy sand. The next part is grayish brown, mottled loamy sand. The lower part to a depth of 60 inches is gray fine sandy loam that has thin strata of loamy sand. In a few areas the dark surface layer is less than 10 inches thick. In some places silty material overlies the loamy sediments. In other places the surface layer is lighter colored, contains more clay, or is a thin layer of muck. In some small areas the subsoil has more clay or less clay. In a few places the underlying material has more clay. In some areas bedrock or calcareous glacial till is within a depth of 60 inches.

Included with this soil in mapping are areas that have not been drained and that remain wet most of the year. Also included are areas of the well drained Fox, Fox Variant, and Ockley soils on the higher parts of the landscape. Included soils make up 5 to 15 percent of the map unit.

The Millgrove soil has a moderate available water capacity. Permeability is moderate in the subsoil and moderately rapid in the underlying material. The organic matter content is high in the surface layer. Runoff is slow to ponded. The water table is near or above the surface during winter and spring.

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

If drained, this soil is well suited to corn, soybeans, and small grain. The wetness and the ponding are the main management concerns. They can hinder the use of equipment. Shallow surface drains and subsurface drains can remove excess water. In some areas, however, adequate outlets are not readily available. Fine sand can flow into subsurface drains and plug them. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface minimize crusting, help to maintain tilth, and increase the organic matter content and the rate of infiltration. The soil is well suited to fall plowing.

If drained, this soil is well suited to grasses, such as bromegrass and reed canarygrass, for hay or pasture. The wetness is the main limitation, and the ponding is a hazard. Because of the high water table, deep-rooted legumes, such as alfalfa, grow poorly in undrained areas. Even if subsurface and shallow surface drains are installed, legumes are damaged because of temporary ponding. Overgrazing or grazing under wet conditions results in surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. The wetness is a limitation. The equipment limitation, seedling mortality, the windthrow hazard, and plant competition are management concerns. Equipment should be used only when the soil is relatively dry or frozen. Special planting stock and overstocking are needed. Special site preparation, such as bedding, is needed in some areas. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Special harvest methods and proper site preparation help to control plant competition.

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

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

MvC—Morley silt loam, 6 to 12 percent slopes. This moderately sloping, deep, well drained soil is on ridges on till plains and moraines. Areas are elongated or irregularly shaped and are 3 to 20 acres in size.

In a typical profile, the surface layer is very dark grayish brown and brown silt loam about 9 inches thick. The subsoil is about 26 inches thick. The upper part is dark yellowish brown, friable silty clay loam; the next part is dark yellowish brown, firm clay loam; and the lower part is brown, firm silty clay and clay loam. The underlying material to a depth of 60 inches is brown clay loam. In some areas the silty material is thicker. In other areas the surface layer has less clay. In some places the subsoil, the underlying material, or both have less clay. In other places the underlying material is stratified. In some areas the soil is deeper to calcareous glacial till. In other areas the slope is less than 6 or more than 12 percent.

Included with this soil in mapping are areas of the somewhat poorly drained Blount soils on slight rises, the moderately well drained Glynwood soils on ridges and knolls, the well drained Hennepin soils on ridges along drainageways, and the poorly drained and very poorly drained Pewamo soils in broad depressions. Hennepin soils are less clayey than the Morley soil. Included soils make up 5 to 10 percent of the map unit.

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

Most areas of this soil are wooded (fig. 9). A few are used for hay, pasture, or cultivated crops.

This soil is fairly well suited to corn, soybeans, and small grain. Erosion is the main hazard. If cultivated crops are grown, measures that control erosion and runoff are needed. Examples are a cropping sequence that includes grasses and legumes, a system of conservation tillage that leaves protective amounts of crop residue on the surface, grassed waterways, and grade stabilization structures. Cover crops and conservation tillage minimize crusting, help to maintain tilth, and increase the organic matter content and the rate of water infiltration.

This soil is well suited to grasses and legumes, such as bromegrass and alfalfa, for hay or pasture. Erosion is the main hazard. Overgrazing or grazing under wet conditions results in surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

Figure 9.—A wooded area of Morley silt loam, 6 to 12 percent slopes.

This soil is well suited to trees. Plant competition is moderate. It can be controlled by special harvest methods and by proper site preparation.

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

Because of low strength, this soil is severely limited as a site for local roads and streets. Strengthening or replacing the base with better suited material improves the ability of the roads and streets to support vehicular traffic.

Because of the slow permeability, this soil is severely limited as a site for septic tank absorption fields. Filling or mounding the absorption field with suitable material improves the capacity of the field to absorb the effluent.

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

MvD—Morley silt loam, 12 to 18 percent slopes. This strongly sloping, deep, well drained soil is on ridges on till plains and moraines. Areas are irregularly shaped and are 4 to 15 acres in size.

In a typical profile, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsoil is about 25 inches thick. The upper part is dark yellowish brown, friable silty clay loam, and the lower part is dark yellowish brown and yellowish brown, firm clay loam. The underlying material to a depth of 60 inches is brown, calcareous clay loam. In some areas the silty material is thicker. In other areas the surface layer contains more clay. In some places the subsoil, the underlying material, or both contain less clay. In other places the underlying material is stratified. In some areas the soil is deeper to calcareous glacial till. In other areas the slope is less than 12 or more than 18 percent.

Included with this soil in mapping are areas of the somewhat poorly drained Blount soils on slight rises, the moderately well drained Glynwood soils on ridges and knolls, the well drained Hennepin soils on ridges along drainageways, and the poorly drained and very poorly drained Pewamo soils in broad depressions. Hennepin soils are less clayey than the Morley soil. Included soils make up 5 to 10 percent of the map unit.

The Morley soil has a moderate available water capacity. Permeability is moderately slow in the subsoil and slow in the underlying material. The organic matter content is moderate in the surface layer. Runoff is rapid.

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

This soil is poorly suited to corn, soybeans, and small grain. Erosion and the slope are management concerns. If cultivated crops are grown, measures that control erosion and runoff are needed. Examples are a cropping sequence that includes grasses and legumes, a system of conservation tillage that leaves protective amounts of crop residue on the surface, and grade stabilization structures. Cover crops and conservation tillage minimize crusting, improve tilth, and increase the organic matter content and the rate of water infiltration. The slope hinders the use of most standard farm machinery.

This soil is fairly well suited to grasses and legumes, such as bromegrass and alfalfa, for hay or pasture. Erosion and the slope are management concerns. Overgrazing or grazing under wet conditions results in surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is fairly well suited to trees. The main management concerns are the erosion hazard, the equipment limitation, and plant competition. Locating logging roads, skid trails, and landings on gentle grades and removing water with water bars, culverts, and drop structures help to control erosion. Operating ordinary crawler tractors and rubber-tired tractors is hazardous because of the slope. Special logging methods, such as yarding the logs uphill with a cable, may be necessary. Special harvest methods and proper site preparation help to control plant competition.

Because of the slope, this soil is severely limited as a site for dwellings. The buildings should be designed so that they conform to the natural slope of the land. Retaining as much of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion.

This soil is severely limited as a site for local roads and streets because of low strength and the slope. The base material should be strengthened or replaced with material that can support vehicular traffic. Cutting and filling and building the roads on the contour help to overcome the slope.

Because of the slow permeability and the slope, this soil is severely limited as a site for septic tank absorption fields. Filling or mounding the absorption field with suitable material improves the capacity of the field to absorb the effluent. Installing the absorption field on the contour helps to overcome the slope.

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

MwC2—Morley clay loam, 6 to 15 percent slopes, eroded. This moderately sloping and strongly sloping, deep, well drained soil is on ridges on till plains and moraines. Areas are irregularly shaped and are 5 to 15 acres in size.

In a typical profile, the surface layer is dark grayish brown clay loam about 8 inches thick. In most areas, part of the original darkened surface layer has been removed by erosion and tillage has mixed the rest with the upper part of the subsoil. The subsoil is dark yellowish brown and yellowish brown, firm clay loam about 16 inches thick. The underlying material to a depth of 60 inches is yellowish brown clay loam. In some areas the silty material is thicker. In other areas the surface layer, the subsoil, or both contain less clay. In some places the underlying material contains less clay. In other places it is stratified. In some areas the soil is deeper to calcareous glacial till. In other areas the slope is less than 6 or more than 15 percent.

Included with this soil in mapping are areas of the somewhat poorly drained Blount soils on slight rises, the moderately well drained Glynwood soils on ridges and knolls, the well drained Hennepin soils on ridges along drainageways, and the poorly drained and very poorly drained Pewamo soils in broad depressions. Hennepin soils are less clayey than the Morley soil. Included soils make up 5 to 10 percent of the map unit.

The Morley soil has a moderate available water capacity. Permeability is moderately slow in the subsoil and slow in the underlying material. The organic matter content is moderately low in the surface layer. Runoff is medium. The surface layer tends to crust or puddle after heavy rains.

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

This soil is fairly well suited to corn, soybeans, and small grain. Erosion is the main hazard. If cultivated crops are grown, measures that control erosion and runoff are needed. Examples are a cropping sequence that includes grasses and legumes, a system of conservation tillage that leaves protective amounts of crop residue on the surface, grassed waterways, and grade stabilization structures. Cover crops and conservation tillage minimize crusting, maintain tilth, and increase the organic matter content and the rate of water infiltration.

This soil is well suited to grasses and legumes, such as bromegrass and alfalfa, for hay or pasture. Erosion is the main hazard. Overgrazing or grazing under wet conditions results in surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment or grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. It can be controlled by special harvest methods and by proper site preparation.

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

This soil is severely limited as a site for local roads and streets because of low strength. Strengthening or replacing the base with better suited material improves the ability of the roads and streets to support vehicular traffic.

Because of the slow permeability, this soil is severely limited as a site for septic tank absorption fields. Filling or mounding the septic tank absorption field with suitable material improves the capacity of the field to absorb the effluent.

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

MxC3—Morley clay, 6 to 15 percent slopes, severely eroded. This moderately sloping and strongly sloping, deep, well drained soil is on ridges on till plains and moraines. Areas are elongated or irregularly shaped and are 3 to 40 acres in size.

In a typical profile, the surface layer is dark grayish brown clay about 8 inches thick. In most areas, part of the original darkened surface layer has been removed by erosion and tillage has mixed the rest with the upper part of the subsoil. The subsoil is about 13 inches of dark yellowish brown, firm clay loam and clay. The underlying material to a depth of 60 inches is yellowish brown clay loam. In some places the surface layer contains less clay. In other places the subsoil or underlying material contains less clay. In some areas the underlying material is stratified. In other areas the soil is deeper to calcareous glacial till. In some places silty material overlies glacial till. In other places the slope is less than 6 or more than 15 percent.

Included with this soil in mapping are areas of the well drained Hennepin soils on ridges along drainageways, the poorly drained and very poorly drained Pewamo soils in broad depressions, the somewhat poorly drained Blount soils on slight rises, and the moderately well drained Glynwood soils on ridges and knolls. Hennepin soils are less clayey than the Morley soil. Included soils make up 5 to 12 percent of the map unit.

The Morley soil has a moderate available water capacity. Permeability is moderately slow in the subsoil and slow in the underlying material. The organic matter content is low in the surface layer. Runoff is medium. The surface layer is cloddy after it has been tilled and tends to crust or puddle after heavy rains.

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

This soil is poorly suited to corn, soybeans, and small grain. Erosion is the main hazard. If cultivated crops are grown, measures that control erosion and runoff are needed. Examples are a cropping sequence that includes grasses and legumes, a system of conservation tillage that leaves protective amounts of crop residue on the surface, grassed waterways, and grade stabilization structures. Cover crops and conservation tillage minimize crusting, improve tilth, and increase the organic matter content and the rate of water infiltration.

This soil is fairly well suited to grasses and legumes, such as bromegrass and alfalfa, for hay and is well suited to pasture. Erosion is the main hazard. Overgrazing or grazing under wet conditions results in surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. Plant competition is moderate. It can be controlled by special harvest methods and by proper site preparation.

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

Because of low strength, this soil is severely limited as a site for local roads and streets. Strengthening or replacing the base with better suited material improves the ability of the roads and streets to support vehicular traffic.

Because of the slow permeability, this soil is severely limited as a site for septic tank absorption fields. Filling or mounding the absorption field with suitable material improves the capacity of the field to absorb the effluent.

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

OcA—Ockley silt loam, 0 to 2 percent slopes. This nearly level, deep, well drained soil is on terraces. Areas are elongated and are 5 to 50 acres in size.

In a typical profile, the surface layer is brown silt loam about 8 inches thick. The subsoil is about 51 inches thick. The upper part is brown, firm clay loam and sandy clay loam; the next part is brown, friable sandy loam and sandy clay loam; and the lower part is dark brown, friable gravelly sandy clay loam. The underlying material to a depth of 60 inches is brown very gravelly coarse sand. In some areas the silty material is thicker. In other areas the surface layer is gravelly. In some places it contains more clay. In other places the subsoil contains less clay. In some areas the subsoil, the underlying material, or both contain more clay. In other areas calcareous glacial till is within a depth of 60 inches. In places the slope is more than 2 percent.

Included with this soil in mapping are the well drained Fox soils in nearly level areas and on ridges and knolls and the very poorly drained Millgrove soils in depressions. Fox soils are moderately deep over sand and very gravelly coarse sand. Included soils make up 5 to 10 percent of the map unit.

The Ockley soil has a moderate available water capacity. Permeability is moderate in the subsoil and very rapid in the underlying material. The organic matter content is moderate in the surface layer. Runoff is slow.

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

This soil is well suited to corn, soybeans, and small grain. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface minimize crusting, improve tilth, and increase the organic matter content and the rate of water infiltration. The soil is well suited to no-till planting. Cobbles at or near the surface hinder fieldwork.

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

This soil is well suited to trees. Plant competition is moderate. It can be controlled by special harvest methods and by proper site preparation.

This soil is suitable as a site for septic tank absorption fields. Because of the shrink-swell potential, it is moderately limited as a site for dwellings. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling.

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

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

Pg—Patton silty clay loam. This nearly level, deep, poorly drained soil is in broad depressions on glacial lake plains. It is frequently ponded by runoff from the higher adjacent areas. Areas are irregularly shaped and are 50 to more than 200 acres in size.

In a typical profile, the surface layer is very dark gray silty clay loam about 8 inches thick. The subsurface layer also is very dark gray silty clay loam. It is about 3 inches thick. The subsoil is dark grayish brown and grayish brown, mottled, firm silty clay loam about 32 inches thick. The underlying material to a depth of 60 inches is grayish brown, mottled silty clay loam and loam. In some places the soil is dark to a depth of less than 10 inches. In other places the surface layer is lighter colored. In some areas it contains less clay. In a few places the subsoil, the underlying material, or both contain more clay. In some areas the subsoil, the underlying material, or both contain less clay. In other areas calcareous glacial till is within a depth of 60 inches. In places the soil is underlain by calcareous sand and gravelly sand.

Included with this soil in mapping are areas of the somewhat poorly drained Crosby soils on slight rises. Also included are some areas that have not been drained and that remain wet most of the year. Included soils make up 5 to 12 percent of the map unit.

The Patton soil has a high available water capacity. Permeability is moderate in the subsoil and moderately slow in the underlying material. The organic matter content is high in the surface layer. Runoff is slow to ponded. The water table is near or above the surface during winter and spring.

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

If drained, this soil is well suited to corn, soybeans, and small grain. The wetness and the ponding are the main management concerns. They can hinder the use of farm equipment. Shallow surface drains and subsurface drains can remove excess water if adequate drainage outlets are available. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface minimize crusting, improve tilth, and increase the organic matter content and the rate of water infiltration. The soil is well suited to fall plowing.

If drained, this soil is well suited to grasses, such as bromegrass and reed canarygrass, for hay or pasture. The wetness is the main limitation, and the ponding is a hazard. Because of the high water table, deep-rooted legumes, such as alfalfa, grow poorly in undrained areas. Even if subsurface and shallow surface drains are installed, legumes are damaged because of temporary ponding. Overgrazing or grazing under wet conditions results in surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. The wetness is a limitation. The equipment limitation, seedling mortality, the windthrow hazard, and plant competition are management concerns. Equipment should be used only when the soil is relatively dry or frozen. Special planting stock and overstocking are needed. Special site preparation, such as bedding, is needed in some areas. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Special harvest methods and proper site preparation help to control plant competition.

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

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

Pw—Pewamo silty clay loam. This nearly level, deep, poorly drained and very poorly drained soil is in broad depressions on till plains and moraines. It is frequently ponded by runoff from the higher adjacent areas. Areas are irregularly shaped and are 2 to more than 100 acres in size.

In a typical profile, the surface layer is very dark gray silty clay loam about 10 inches thick. The subsoil is about 39 inches thick. It is mottled and firm. The upper part is dark gray and gray silty clay loam, and the lower part is gray clay loam. The underlying material to a depth of 60 inches is gray, mottled clay loam. In some areas the dark surface layer is less than 10 inches thick. In other areas the surface layer is lighter colored. In some places it is a thin layer of muck. In other places the silty material is thicker. In some areas the surface layer contains less clay. In other areas the subsoil, the underlying material, or both contain less clay. In some places the underlying material is stratified. In other places the slope is more than 2 percent.

Included with this soil in mapping are areas of the somewhat poorly drained Blount soils on slight rises, the moderately well drained Glynwood and well drained Morley soils on ridges and knolls, and the very poorly drained Houghton and Wallkill soils in depressions. Houghton soils formed in thick deposits of organic material. Wallkill soils are underlain by organic material. Also included are some areas that have not been drained and that remain wet most of the year. Included soils make up 5 to 15 percent of the map unit.

The Pewamo soil has a high available water capacity and is moderately slowly permeable. The organic matter content is high in the surface layer. Runoff is very slow or ponded. The water table is near or above the surface during winter and spring.

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

If drained, this soil is well suited to corn, soybeans, and small grain. The wetness and the ponding are the main management concerns. They can hinder the use of farm equipment. Shallow surface drains and subsurface drains can remove excess water if adequate drainage outlets are available. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface minimize crusting, improve tilth, and increase the organic matter content and the rate of water infiltration (fig. 10). The soil is well suited to fall plowing.

If drained, this soil is well suited to grasses, such as bromegrass and reed canarygrass, for hay and pasture. The wetness is the main limitation, and the ponding is a hazard. Because of the high water table, deep-rooted legumes, such as alfalfa, grow poorly in undrained areas. Even if subsurface and shallow surface drains are installed, legumes are damaged because of temporary ponding. Overgrazing or grazing under wet conditions results in surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. The wetness is a limitation. The equipment limitation, seedling mortality, the windthrow hazard, and plant competition are management concerns. Equipment should be used only when the soil is relatively dry or frozen. Special planting stock and overstocking are needed. Special site preparation, such as bedding, is needed in some areas. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Special harvest methods and proper site preparation help to control plant competition.

Because of the ponding, this soil is generally unsuitable as a site for dwellings and sanitary facilities. Because of low strength, ponding, and frost action, it is severely limited as a site for local roads. Strengthening

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

or replacing the base with better suited material improves the ability of the roads to support vehicular traffic. Constructing the roads on raised, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by ponding and frost action.

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

Py—Pits. This nearly level to steep map unit consists of gravel pits and limestone quarries. The gravel pits are on terraces and uplands. The limestone quarries are in the uplands in the western part of the county (fig. 11). Areas are irregularly shaped and are 2 to 60 acres in size.

Typically, the soil has been removed and the sand and gravel or limestone bedrock is exposed. The outer edges of the pits commonly have vertical sides. The limestone quarries are in areas of Pewamo and Blount soils where bedrock is at a depth of 10 to 20 feet. The gravel pits are along the Mississinewa River and its tributaries.

Figure 11.—A limestone quarry in the western part of Grant County.

Included in this unit in mapping are small areas where the overburden has been stockpiled and small areas where water covers the bottom of the pit. Also included are some areas where all of the sand and gravel has been removed and glacial till is exposed. Included areas make up 5 to 15 percent of the map unit.

Available water capacity, permeability, organic matter content, runoff, and the depth to the water table vary widely.

Most areas are mined for limestone or for sand and gravel. The limestone is used as aggregate for roads and as a source of agricultural lime. The sand and gravel are used for road building and for making concrete.

This map unit is generally unsuited to cultivated crops, hay, pasture, woodland, and recreational development. Major land reclamation is needed before it can be used for these purposes. Erosion is a hazard. The application of conservation practices is limited by the irregular topography. Onsite investigation is needed to determine soil properties and engineering test data before structures can be built on this unit.

No land capability classification or woodland ordination symbol is assigned to this map unit.

Sn—Sloan clay loam, occasionally flooded. This nearly level, deep, very poorly drained soil is in depressions on flood plains. It is occasionally flooded for brief or long periods during fall, winter, and spring. Areas are elongated and are 10 to more than 200 acres in size.

In a typical profile, the surface layer is very dark gray clay loam about 10 inches thick. The subsoil is dark gray and gray, mottled, firm clay loam about 25 inches thick. The upper part of the underlying material is gray clay loam and loam. The lower part to a depth of 60 inches is gray sandy loam that has thin strata of loam. In some areas the dark surface layer is less than 10 inches thick. In other areas the surface layer is lighter colored. In some places it contains less clay. In other places it is a thin layer of muck. In some areas the subsoil, the underlying material, or both contain more clay or less clay. In other areas bedrock or calcareous glacial till is within a depth of 60 inches. In places the soil is underlain by calcareous sand and gravelly sand.

Included with this soil in mapping are areas of the well drained and moderately well drained Landes soils on slight rises. Also included are some areas that are frequently flooded for long periods and areas that have not been drained and that remain wet most of the year. Included soils make up 5 to 10 percent of the map unit.

The Sloan soil has a high available water capacity and is moderately permeable or moderately slowly permeable. The organic matter content is high in the surface layer. Runoff is very slow. The water table is at or near the surface during fall, winter, and spring.

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

If drained, this soil is fairly well suited to corn and soybeans. The wetness is the main limitation, and the flooding is a hazard. Subsurface drains and shallow surface drains can remove excess water if adequate drainage outlets are available. Planting late in the spring or replanting is sometimes needed because of the flooding. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface minimize crusting, improve tilth, and increase the organic matter content and the rate of water infiltration.

If drained, this soil is well suited to grasses, such as bromegrass and reed canarygrass, for hay or pasture. The wetness is the main limitation, and the flooding is a hazard. Because of the high water table, deep-rooted legumes, such as alfalfa, grow poorly in undrained areas. Even if subsurface and shallow surface drains are installed, legumes are damaged because of temporary flooding. Overgrazing or grazing under wet conditions results in surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. The wetness is a limitation. The equipment limitation, seedling mortality, the windthrow hazard, and plant competition are management concerns. Equipment should be used only when the soil is relatively dry or frozen. Special planting stock and overstocking are needed. Special site preparation, such as bedding, is needed in some areas. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Special harvest methods and proper site preparation help to control plant competition.

Because of the flooding, this soil is generally unsuitable as a site for dwellings and sanitary facilities. A suitable alternative site should be selected. The soil is severely limited as a site for local roads because of low strength, the flooding, and the wetness. Strengthening or replacing the base with better suited material improves the ability of the roads to support vehicular traffic. Constructing the roads on raised, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by floodwater and wetness.

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

St—Sloan silt loam, sandy substratum, occasionally flooded. This nearly level, deep, very poorly drained soil is in depressions on flood plains. It is occasionally flooded for brief or long periods during fall, winter, and spring. Areas are elongated and are 10 to more than 50 acres in size.

In a typical profile, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer also is very dark grayish brown silt loam. It is about 6 inches thick. The subsoil is about 24 inches thick. The upper part is dark grayish brown, mottled, friable silt loam, and the lower part is dark gray, mottled, firm loam and clay loam. The upper part of the underlying material is gray, mottled loam and sandy loam. It has thin strata of loamy sand. The next part is dark grayish brown loamy coarse sand. The lower part to a depth of 60 inches is grayish brown coarse sand. In some areas the dark surface layer is less than 10 inches thick. In other areas the surface layer is lighter colored. In some places it contains more sand. In other places the silty material is thicker. In some areas the subsoil contains less clay. In other areas the subsoil, underlying material, or both contain more clay. In places bedrock or calcareous glacial till is within a depth of 60 inches.

Included with this soil in mapping are areas of the well drained and moderately well drained Landes soils on slight rises. Also included are some areas that have not been drained and that remain wet most of the year and some areas that are frequently flooded for long periods. Included soils make up 5 to 10 percent of the map unit.

The Sloan soil has a high available water capacity. Permeability is moderate or moderately slow in the subsoil and in the upper part of the substratum and rapid in the lower part of the substratum. The organic matter content is high in the surface layer. Runoff is very slow. The water table is at or near the surface during fall, winter, and spring.

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

If drained, this soil is fairly well suited to corn and soybeans. The wetness is the main limitation, and the flooding is a hazard. Subsurface drains and shallow surface drains can remove excess water if adequate outlets are available. Planting late in the spring or replanting is sometimes needed because of the flooding. Cover crops and a system of conservation tillage that leaves protective amounts of crop residue on the surface minimize crusting, improve tilth, and increase the organic matter content and the rate of water infiltration.

If drained, this soil is well suited to grasses, such as bromegrass and reed canarygrass, for hay or pasture. The wetness is the main limitation, and the flooding is a hazard. Because of the high water table, deep-rooted legumes, such as alfalfa, grow poorly in undrained areas. Even if subsurface and shallow surface drains are installed, legumes are damaged because of temporary flooding. Overgrazing or grazing under wet conditions results in surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is well suited to trees. The wetness is a limitation. The equipment limitation, seedling mortality, the windthrow hazard, and plant competition are management concerns. Equipment should be used only when the soil is relatively dry or frozen. Special planting stock and overstocking are needed. Special site preparation, such as bedding, is needed in some areas. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Special harvest methods and proper site preparation help to control plant competition.

Because of the flooding, this soil is generally unsuitable as a site for dwellings and sanitary facilities. A suitable alternative site should be selected. Because of low strength, the flooding, and the wetness, the soil has severe limitations as a site for local roads. Strengthening or replacing the base with better suited material improves the ability of the roads to support vehicular traffic. Constructing the roads on raised, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by floodwater and wetness.

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

Ud—Udorthents, loamy. These nearly level to moderately sloping, shallow to deep, well drained to somewhat poorly drained soils are in disturbed areas on till plains, moraines, terraces, and flood plains. They are around highway interchanges, in shopping centers, in gravel pits and limestone quarries, in sanitary landfills, on sites for factories, and in agricultural areas. In some places, deep cuts have been made in the original land surface and the soil material is used as fill when lower areas are smoothed and leveled. In other places the soil material has been removed and used as fill on highways, overpasses, and exit ramps. Many borrow areas are filled with water and are used for various types of recreation and wildlife habitat. Areas are irregularly shaped and are 3 to 50 acres in size.

This soil material is a mixture of surface soil, subsoil, and underlying material. It is loamy, clayey, or silty and may contain some sand and gravel, siltstone, limestone, shale, cobbles, or stones. It is slightly acid to moderately alkaline. In a typical area where a deep cut has been made, the material is mainly loam, silty clay loam, or clay loam calcareous glacial till.

Included with these soils in mapping are small areas that have short, steep slopes and areas where bedrock crops out. Also included are some areas that are wet during all or part of the year and some areas where highways, highway interchanges, other public works, and buildings cover much of the surface. Included areas make up 10 to 15 percent of the map unit.

The Udorthents have a moderate or high available water capacity and are moderately permeable to slowly permeable. The surface layer is very low in organic matter content and is firm. Tilth is poor in this layer. Runoff is slow to rapid.

Most areas of these soils support a permanent layer of grasses or low-growing shrubs. Many are surrounded by heavily traveled highways. Access is limited.

The suitability of these soils for cultivated crops, pasture, woodland, building site development, and recreational uses varies greatly. Onsite investigation is needed to determine all of the hazards and limitations that affect these uses. If cultivated crops are grown, special management is needed. An example is an intensified fertility program that emphasizes the incorporation of organic residue or manure into the soils. Measures that control erosion are needed in the gently sloping and moderately sloping areas. Examples are diversions, box inlet structures, grade stabilization structures, and grassed waterways. Exposed areas should be revegetated as soon as possible after construction. Reclamation, revegetation, and erosion control are extremely difficult, especially in the more sloping areas.

No land capability classification and woodland ordination symbol is assigned to these soils.

UfB—Urban land-Fox complex, 1 to 6 percent slopes. This map unit occurs as areas of Urban land intermingled with areas of a nearly level and gently sloping, well drained Fox soil. The unit is on terraces, mainly in the city of Marion. The Fox soil is moderately deep over sand and gravelly coarse sand. Areas are elongated and are 20 to 50 acres in size.

Urban land makes up 60 to 85 percent of the mapped areas. In a typical area, streets, parking lots, shopping centers, buildings, and other structures cover the surface, so that identification of the soil series is not feasible.

In a typical profile of the Fox soil, the surface layer is brown silt loam about 9 inches thick. The subsoil is about 26 inches thick. The upper part is dark yellowish brown, friable clay loam, and the lower part is brown and dark reddish brown, friable gravelly sandy clay loam. The underlying material to a depth of 60 inches is yellowish brown very gravelly coarse sand. In some areas the silty material is thicker. In other areas the surface layer is gravelly or cobbly. In some places the surface layer, the subsoil, or both contain more clay. In other places the subsoil is grayer. In some areas the subsoil, the underlying material, or both contain more clay. In other areas the soil is shallower to calcareous sand and very gravelly coarse sand. In some places calcareous glacial till or bedrock is within a depth of 60 inches. In other places the slope is less than 1 or more than 6 percent.

Included in this unit in mapping are the well drained Fox Variant soils in nearly level areas and on ridges and knolls, the well drained Ockley soils in nearly level areas, and the very poorly drained Millgrove soils in depressions. Fox Variant soils are underlain by bedrock. Ockley soils are deeper to sand and very gravelly coarse sand than the Fox soil. Also included are areas where bedrock crops out. Included areas make up 8 to 15 percent of the map unit.

The Fox soil has a moderate available water capacity. Permeability is moderate in the subsoil and very rapid in the underlying material. The organic matter content is moderate in the surface layer. Runoff is slow or medium.

Most areas of the Fox soil are used for building site development. A few are idle or are used as playgrounds or other recreational areas. This soil is generally not used for cultivated crops, pasture, or woodland. If small areas are used for garden plots or lawns, lime and fertilizer should be added according to plant needs and the results of soil tests. If trees and shurbs are planted, competing plants should be controlled until the seedlings are established.

The Fox soil is suitable as a site for dwellings with basements. It is moderately limited as a site for dwellings without basements because of the shrink-swell potential. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. Retaining as much of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion.

Because of the frost action and the shrink-swell potential, the Fox soil is moderately limited as a site for local roads and streets. Constructing the roads and streets on raised, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by frost action. Strengthening or replacing the base with better suited material improves the ability of the roads and streets to support vehicular traffic.

Because of a poor filtering capacity, the Fox soil is severely limited as a site for septic tank absorption fields. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water supplies.

No land capability classification or woodland ordination symbol is assigned to this map unit.

UhB—Urban land-Glynwood complex, 2 to 6 percent slopes. This map unit occurs as areas of Urban land intermingled with areas of a gently sloping, deep, moderately well drained Glynwood soil. The unit is on ridges and knolls on till plains and moraines, mainly in the city of Marion. Areas are irregularly shaped and are 10 to 45 acres in size.

Urban land makes up 60 to 85 percent of the mapped areas. In a typical area, streets, parking lots, shopping centers, buildings, and other structures cover the surface, so that identification of the soil series is not feasible.

In a typical profile of the Glynwood soil, the surface layer is brown silt loam about 8 inches thick. The subsoil is about 23 inches thick. It is mottled and firm. The upper part is yellowish brown silty clay loam, and the lower part is dark yellowish brown clay loam. The underlying material to a depth of 60 inches is yellowish brown clay loam. In some places the surface layer contains more clay. In other places the silty material is thicker. In some areas the subsoil, the underlying material, or both contain less clay. In other areas the underlying material is stratified. In some places the soil is deeper to calcareous glacial till. In other places the slope is less than 2 or more than 6 percent.

Included in this unit in mapping are areas of the somewhat poorly drained Blount soils on slight rises, the well drained Hennepin soils on ridges along drainageways, the well drained Morley soils on ridges, and the poorly drained and very poorly drained Pewamo soils in broad depressions. Included soils make up 8 to 15 percent of the map unit.

The Glynwood soil has a moderate available water capacity and is slowly permeable. The organic matter content is moderate in the surface layer. Runoff is medium. The water table is at a depth of 2.0 to 3.5 feet in winter and spring.

Most areas of the Glynwood soil are used for building site development. A few are idle or are used as playgrounds or other recreational areas. This soil is generally not used for cultivated crops, pasture, or woodland. If small areas are used for garden plots or lawns, lime and fertilizer should be added according to plant needs and the results of soil tests. If trees and shrubs are planted, competing plants should be controlled until the seedlings are established. Special planting stock and special site preparation reduce the seedling mortality rate.

Because of the wetness and the shrink-swell potential, the Glynwood soil is moderately limited as a site for dwellings without basements. It is severely limited as a site for dwellings with basements because of the wetness. Building the dwellings on raised, well compacted fill material and installing subsurface drains help to overcome the wetness. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. Retaining as much of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion.

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

Because of the wetness and the slow permeability, the Glynwood soil is severely limited as a site for septic tank absorption fields. Perimeter subsurface drains are needed to lower the water table. Filling or mounding the absorption field with suitable material improves the capacity of the field to absorb the effluent.

No land capability classification or woodland ordination symbol is assigned to this map unit.

UmC—Urban land-Morley complex, 6 to 15 percent slopes. This map unit occurs as areas of Urban land intermingled with areas of a moderately sloping and strongly sloping, deep, well drained Morley soil. The unit is on ridges on till plains and moraines, mainly in the city of Marion. Areas are irregularly shaped or elongated and are 5 to 25 acres in size.

Urban land makes up about 60 to 85 percent of the mapped areas. In a typical area, streets, parking lots, shopping centers, buildings, and other structures cover the surface, so that identification of the soil series is not feasible.

In a typical profile of the Morley soil, the surface layer is dark grayish brown clay loam about 8 inches thick. The subsoil is dark yellowish brown and yellowish brown, firm clay loam about 16 inches thick. The underlying material to a depth of 60 inches is yellowish brown, calcareous clay loam. In some places the surface layer contains less clay. In other places the subsoil, the underlying material, or both contain less clay. In some areas the underlying material is stratified. In other areas the soil is deeper to calcareous glacial till. In some places bedrock is within a depth of 60 inches. In other places the slope is less than 6 or more than 15 percent.

Included in this unit in mapping are areas of the somewhat poorly drained Blount soils on slight rises, the moderately well drained Glynwood soils on ridges and knolls, the well drained Hennepin soils on ridges along drainageways, and the poorly drained and very poorly drained Pewamo soils in broad depressions. Hennepin soils are less clayey than the Morley soil. Included soils make up 8 to 15 percent of the map unit.

The Morley soil has a moderate available water capacity. Permeability is moderately slow in the subsoil and slow in the underlying material. The organic matter content is moderately low in the surface layer. Runoff is medium.

Most areas of the Morley soil are used for building site development. A few are idle or are used as playgrounds or other recreational areas. This soil is generally not used for cultivated crops, pasture, or woodland. If small areas are used for garden plots or lawns, lime and fertilizer should be added according to plant needs and the results of soil tests. If trees and shrubs are planted, competing plants should be controlled until the seedlings are established.

The Morley soil is moderately limited as a site for dwellings because of the slope and the shrink-swell potential. The buildings should be designed so that they conform to the natural slope of the land. Strengthening foundations, footings, and basement walls and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. Retaining as much of the existing vegetation as possible during construction and revegetating disturbed areas as soon as possible help to control erosion. Low strength is a severe limitation if the Morley soil is used as a site for local roads and streets. The base material should be strengthened or replaced with material that can support vehicular traffic.

The Morley soil is severely limited as a site for septic tank absorption fields because of the slow permeability. Filling or mounding the absorption field with suitable material improves the capacity of the field to absorb the effluent.

No land capability classification or woodland ordination symbol is assigned to this map unit.

Ut—Urban land-Pewamo complex. This map unit occurs as areas of Urban land intermingled with areas of a nearly level, deep, poorly drained and very poorly drained Pewamo soil. The unit is in broad depressions on till plains and moraines, mainly in the city of Marion. Areas are irregularly shaped and are 500 to more than 1,500 acres in size.

Urban land makes up 60 to 85 percent of the mapped areas. In a typical area, streets, parking lots, shopping centers, buildings, and other structures cover the surface, so that identification of the soil series is not feasible.

In a typical profile of the Pewamo soil, the surface layer is very dark gray silty clay loam about 10 inches thick. The subsoil is about 39 inches thick. It is mottled and firm. The upper part is dark gray and gray silty clay loam, and the lower part is gray clay loam. The underlying material to a depth of 60 inches is gray, mottled clay loam. In some areas the dark surface layer is less than 10 inches thick. In other areas the surface layer is lighter colored. In a few areas the silty material is thicker. In some places the surface layer contains less clay. In other places the subsoil is browner. In some areas the subsoil, underlying material, or both contain less clay. In other areas the underlying material is stratified. In some places bedrock is within a depth of 60 inches. In other places the surface layer is muck. In some areas the slope is more than 2 percent.

Included in this unit in mapping are areas of the somewhat poorly drained Blount soils on slight rises, the moderately well drained Glynwood and well drained Morley soils on ridges and knolls, and the very poorly drained Houghton and Wallkill soils in depressions. Houghton soils formed in thick organic deposits, and Wallkill soils are underlain by organic material. Also included are some areas that have not been drained and that remain wet most of the year. Included soils make up 8 to 15 percent of the map unit.

The Pewamo soil has a high available water capacity. It is moderately slowly permeable. The organic matter content is high in the surface layer. Runoff is very slow or ponded. The water table is near or above the surface during winter and spring.

Most areas of the Pewamo soil are used for building site development. A few are idle or are used as playgrounds or other recreational areas. This soil is generally not used for cultivated crops, pasture, or woodland. If small areas are used for garden plots or lawns, lime and fertilizer should be added according to plant needs and the results of soil tests. If trees and shrubs are planted, competing plants should be controlled until the seedlings are established. Special planting stock and special site preparation reduce the seedling mortality rate.

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

No land capability classification or woodland ordination symbol is assigned to this map unit.

Wa—Wallkill silt loam, undrained. This nearly level, deep, very poorly drained soil is in depressions on glacial lake plains. It is frequently ponded by runoff from the higher adjacent areas. Areas are irregularly shaped or circular and are 2 to 15 acres in size.

In a typical profile, the surface soil is very dark gray silt loam about 9 inches thick. The subsoil is about 14 inches of very dark gray, mottled, friable silt loam that has very thin strata of grayish brown loam. The underlying material is about 7 inches of very dark grayish brown, mottled, friable silt loam that has very thin strata of grayish brown loam. Below this to a depth of 60 inches is dark brown muck. In some places the surface layer contains more clay. In other places the mineral material is less than 16 inches thick. In some areas the subsoil, the underlying material, or both contain more clay.

Included with this soil in mapping are areas of the very poorly drained Bono and Houghton soils in depressions and the poorly drained and very poorly drained Pewamo soils in broad depressions. Bono and Pewamo are deep, mineral soils. Houghton soils formed in thick organic deposits. Also included are some areas that have sedimentary peat or mineral material at a depth of 20 to 60 inches and some areas that are drained. Included soils make up 5 to 15 percent of the map unit.

The Wallkill soil has a very high available water capacity. Permeability is moderate in the mineral material and moderately rapid or rapid in the organic material. The organic matter content is high in the surface layer. Runoff is slow to ponded. The water table is near or above the surface during fall, winter, and spring.

Most areas are idle or are used for pasture. A few are used for hay. The idle areas support a cover of native hardwoods, wetland shrubs, and grasses.

This soil is generally unsuited to corn, soybeans, and small grain and to grasses and legumes for hay or pasture. The wetness is the main limitation, and the ponding is a severe hazard. In areas of native pasture, overgrazing or grazing under wet conditions results in surface compaction and poor tilth.

This soil is poorly suited to trees. The wetness is a limitation. The equipment limitation, seedling mortality, the windthrow hazard, and plant competition are management concerns. Equipment should be used only when the soil is relatively dry or frozen. Special planting stock and overstocking are needed. Special site preparation, such as bedding, is needed in some areas. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the windthrow hazard. Special harvest methods and proper site preparation help to control plant competition.

Because of the ponding, this soil is generally unsuitable as a site for dwellings, local roads, and sanitary facilities. A suitable alternative site should be selected.

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

Prime Farmland

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

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 198,000 acres in the survey area, or nearly 75 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county, but most are in the western and northeastern parts, mainly in associations 1, 2, 3, 4, 5, 8, and 9, which are described under the heading "General Soil Map Units." On about 166,000 acres, the soil meets the requirements only in areas where it is drained. About 183,000 acres of the prime farmland is used for crops, mainly corn, soybeans, and small grain.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table qualify for prime farmland only in areas where this limitation has been overcome by drainage measures. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not this limitation has been overcome by corrective measures.

Use and Management of the Soils

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

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

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

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

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where 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 Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

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

Approximately 177,402 acres in the county was used for crops and pasture in 1974. Of this total, 12,441 acres was used for pasture; 160,924 acres was harvested cropland; and 4,037 acres was idle cropland, was used for soil improvement crops or cultivated summer fallow, or was land on which crops had failed (*10*).

The potential of the soils in Grant County for increased food production is good. In 1974, about 7,670 acres of potentially good cropland was used as woodland and about 8,086 acres as pasture. In addition to the reserve productive capacity represented by this land, food production could also be increased considerably by extending the latest crop production technology to all cropland in the county. This soil survey can greatly aid in the application of such technology.

The paragraphs that follow describe the major management concerns in the areas of the county used for crops and pasture. These concerns are wetness, flooding, erosion, soil blowing, fertility, and tilth.

Wetness is the major problem on about 63 percent of the cropland and pasture in the county. Most areas of the poorly drained and very poorly drained soils, such as Bono, Houghton, Pewamo, and Sloan soils, are adequately drained. A few areas of these soils in depressions, however, cannot be economically drained. Subsurface drains would have to be deep and would have to extend for a great distance to a suitable outlet. Unless drained, the somewhat poorly drained soils are so wet that crops are damaged in most years. Examples are Blount and Crosby soils.

Fox, Morley, and Ockley soils are naturally well drained, but they tend to dry out in the summer. Small areas of wetter soils along drainageways and in swales are commonly included with these soils in mapping, especially where the slope is 0 to 6 percent. A drainage system is needed in some of these included areas.

The design of surface and subsurface drainage systems depends on the kind of soil. A combination of surface and subsurface drains is needed in most areas of the poorly drained and very poorly drained soils that are intensively row cropped. The drains should be more closely spaced in slowly permeable soils than in the more rapidly permeable soils. Subsurface drainage is slow in areas of the Bono soils. Locating adequate outlets for tile drainage is difficult in many areas of Bono and Houghton soils.

Houghton and other organic soils oxidize and subside when the pore space is filled with air. Therefore, special drainage systems are needed to control the depth and period of drainage. Keeping the water table at the level required by the crops during the growing season and raising it to the surface during the rest of the year minimize oxidation and subsidence of these soils.

Information about the design of drainage systems for each kind of soil is given in the Technical Guide, available in local offices of the Soil Conservation Service.

Flooding is a hazard on the flood plains in the county. Landes and Sloan soils are flooded during winter and early spring in most years. This flooding generally does not occur during the cropping season, but it occasionally results in crop losses.

Erosion is the major problem on about 30 percent of the cropland and pasture in the county (fig. 12). It is a hazard on soils that have a slope of more than 2 percent.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the original surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils that have a fine textured or moderately fine textured subsoil, such as Blount and Crosby soils, and on soils that have a layer in or below the subsoil that limits the depth of the root zone. Erosion also reduces the productivity of soils that tend to be droughty, such as Fox soils. Second, erosion results in sedimentation in streams. Control of erosion minimizes this pollution and improves the quality of water for municipal use, for recreation, and for fish and wildlife.

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

Erosion-control practices provide a protective cover, reduce the runoff rate, and increase the rate of water infiltration. A cropping system that keeps a vegetative cover on the soil for extended periods can hold soil losses to an amount that does not reduce the productive capacity of the soils. On livestock farms, where pasture and hay are needed, including forage crops of grasses and legumes in the cropping sequence reduces the susceptibility of the more sloping land to erosion and provides nitrogen and improves tilth for the following crop.

On the more sloping soils in Grant County, slopes are so short and irregular that contour farming and terracing are generally not practical. On these soils a cropping system that provides a substantial vegetative cover is needed to help control erosion unless conservation tillage is applied. Minimizing tillage and leaving crop residue on the surface increase the rate of water infiltration and help to control runoff and erosion. These measures can be applied on most soils in the county. They are less successful, however, on severely eroded soils and on soils that have a moderately fine textured surface layer, such as Patton and Pewamo soils. No-till corn, which is being grown on an increasing acreage, is effective in controlling erosion on the more sloping land. It is suited to most of the soils in the county. It is less successful, however, on the soils that have a moderately fine textured or fine textured surface layer.

Water- and sediment-control basins are effective in controlling the erosion caused by concentrated flow and thus are very effective in reducing the susceptibility to rill and gully erosion. These measures are most practical on Sloan and other deep, well drained soils that are highly susceptible to erosion. These basins reduce soil loss and the associated loss of fertilizer elements; help to prevent the damage to crops and watercourses caused by eroding sediment; help to eliminate the need for grassed waterways, which take productive land out of row crop production; and reduce the amount of pesticides entering watercourses. Soils that have bedrock within a depth of 40 inches, such as the Fox Variant, are less well suited to these basins than other soils.

Grassed waterways are needed in many areas of the more sloping soils, such as Glynwood. They also are needed in some areas where a large watershed drains across Blount and Pewamo soils. A subsurface drainage system is generally needed beneath the waterways established on these soils. It also is needed in seepy areas of Morley soils along drainageways.

Many grade stabilization structures are needed in the county because of the large number of open ditches. These structures help to control erosion in areas where runoff drains into an open ditch. Also, they are commonly needed in open ditches where an excessive gradient results in erosion of the sides and bottom of some channels. Riprap helps to stabilize ditchbanks in areas where the banks tend to cave in (fig. 13).

Soil blowing is a hazard in drained areas of the mucky Houghton soils. It can damage these soils in a few hours if winds are strong and the soils are dry and bare of vegetation or surface mulch. Dark, mineral soils are subject to soil blowing if they are bare. Also, soils that are plowed in the fall are very susceptible to soil blowing the following spring. Maintaining a vegetative cover or surface mulch and keeping the surface rough through proper tillage methods minimize soil blowing. Windbreaks of suitable shrubs also are effective in controlling soil blowing.

Fertility is naturally low or medium in most of the soils on uplands and terraces in the county. The soils on flood plains, such as Landes and Sloan, are neutral or mildly alkaline and are naturally higher in content of plant nutrients than most of the soils on uplands and terraces. The poorly drained and very poorly drained soils, such as Bono, Pewamo, and Houghton, are in slight depressions and receive runoff from the adjacent upland soils. They generally are slightly acid or neutral.

Most of the soils on uplands and terraces naturally are strongly acid or medium acid. Applications of ground limestone generally are needed to raise the pH level for good production of alfalfa and other crops that grow well only on neutral soils. Available phosphorus and potash levels are naturally low in most of these soils. On all soils additions of lime and fertilizer should be based on the results of soil tests, on the needs of the crop, and on the expected level of yields. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime to be applied.

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

Many of the soils used for crops in the county have a silt loam or silty clay loam surface layer that is moderately dark or dark and is moderate or high in content of organic matter. Generally, the structure of these soils is moderate to weak. A surface crust forms during periods of heavy rainfall. When dry, the crust is hard and impervious to water. Regular additions of crop residue, manure, or other organic material improve soil structure and minimize crusting.

Fall plowing is generally not a good means of improving the tilth of light colored silt loams, clay loams, or silty clay loams because a crust forms during winter and spring. Many of these soils are nearly as dense and hard at planting time as they were before they were plowed in the fall. Also, about 30 percent of the cropland consists of sloping soils that are subject to erosion if they are plowed in the fall.

Figure 13.—Riprap along the sides of an open ditch in an area of Millgrove soils.

Tilth is a problem in the dark, medium textured to fine textured Bono, Patton, Pewamo, and Sloan soils, which often stay wet until late in spring. If plowed when wet, these soils tend to be very cloddy when dry. Because of the cloddiness, preparing a good seedbed is difficult. Fall plowing generally results in good tilth in the spring.

Field crops suited to the soils and climate of the county include corn, soybeans, and winter wheat.

Forage crops are well suited to the soils and climate of the county. Alfalfa and red clover are the most commonly grown legumes. They are best suited to well drained soils but can be grown on very poorly drained soils if surface and subsurface drains remove excess water. Timothy, Kentucky bluegrass, bromegrass, and orchardgrass are the most commonly grown grasses on well drained soils. Reed canarygrass and tall fescue are grown in the wetter areas that cannot be adequately drained.

Specialty crops grown in Grant County include popcorn and tomatoes. The latest information about growing these crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

Yields Per Acre

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

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

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

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

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

Land Capability Classification

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

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

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

Class I soils have few limitations that restrict their use.

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

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

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

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

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

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

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

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

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

The acreage of soils in each capability class and subclass is shown in table 7. The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in the yields table.

Woodland Management and Productivity

Michael D. Warner, forester, Soil Conservation Service, helped prepare this section.

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

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The number 1 indicates low potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; *F*, a high content of rock fragments in the soil; and *L*, low strength. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, F, and L.

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

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, fire lanes, and log-handling areas. Forests that have been burned or overgrazed are also subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment or season of use is not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

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

The *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced on a fully stocked, even-aged, unmanaged stand.

The first species listed under *common trees* for a soil is the indicator species for that soil. It is the dominant species on the soil and the one that determines the ordination class.

Trees to plant are those that are suitable for commercial wood production.

Windbreaks and Environmental Plantings

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

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

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

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

Recreation

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

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

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

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

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

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

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

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

Wildlife Habitat

James D. McCall, wildlife biologist, Soil Conservation Service, and Joe M. Scheidler, wildlife management biologist, Indiana Department of Natural Resources, helped prepare this section.

The quality of wildlife habitat in Grant County is comparable to that of most counties in north-central Indiana. Some of the best habitat is in areas along the Mississinewa River and other streams (fig. 14) and in the areas that remain wooded. The wooded areas have a good population of squirrels and a steadily increasing deer herd. The county provides habitat for various populations of other game species, such as fox, coyote, raccoon, and cottontail rabbit, and for songbirds and other nongame wildlife.

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

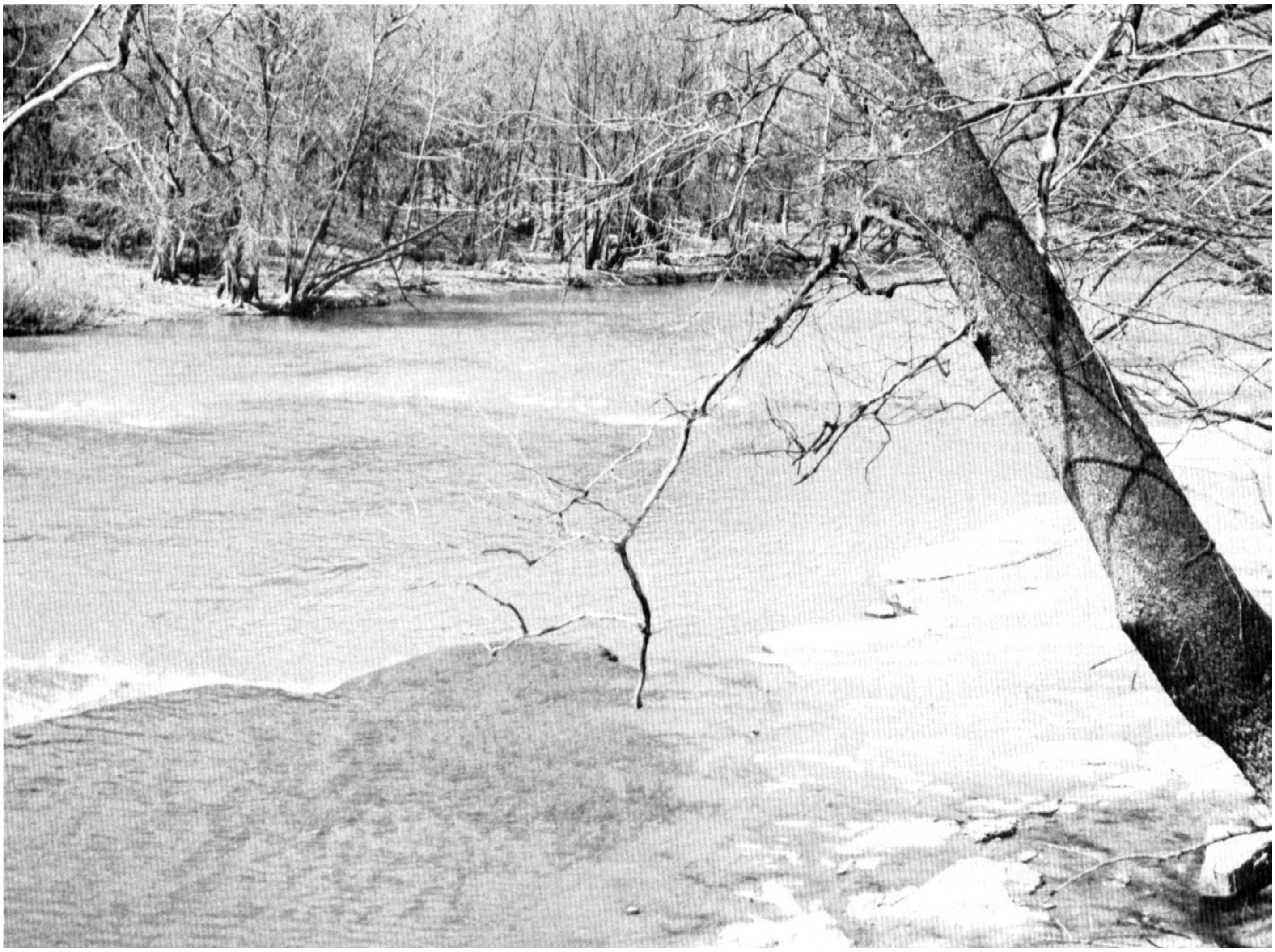

Figure 14.—Habitat for wildlife in an area of Fox Variant soils along the Mississinewa River.

suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

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

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

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

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

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

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these are oak, maple, poplar, beech, wild cherry, black willow, black walnut, apple, hawthorn, dogwood, hickory, blackberry, and elderberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are dogwood, 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, slope, and surface stoniness. Examples of wetland plants are smartweed, spikerush, wild millet, cattail, waterplantain, arrowhead, rushes, sedges, and reeds.

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

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

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

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

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

Edge habitat consists of areas where major land uses or cover types adjoin. A good example is the border between dense woodland and a field of no-till corn. Although not rated in the table, edge habitat is of primary importance to animals from the smallest songbirds to white-tailed deer. Most of the animals that inhabit openland or woodland also frequent edge habitat, and desirable edge areas are consistently used by 10 times as many wildlife as are the centers of large areas of woodland or cropland.

Engineering

Max L. Evans, state conservation engineer, and Robert D. Wiwi, agricultural engineer, Soil Conservation Service, helped prepare this section.

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

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

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

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

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

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

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

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

Building Site Development

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

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

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

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. 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 landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

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

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to 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 due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

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

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

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

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

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

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

Construction Materials

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Water Management

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

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

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

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

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

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

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

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

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

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

Soil Properties

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

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

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

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

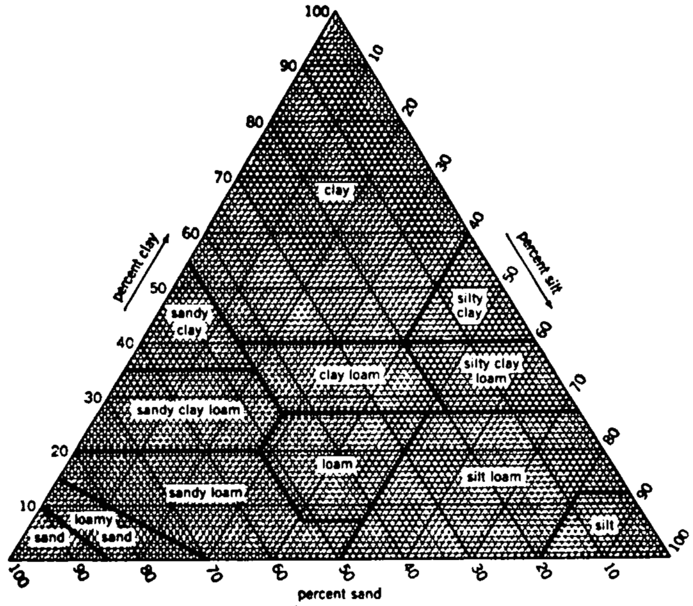

Figure 15.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

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 "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. 15). "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 (*3*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

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

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

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

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

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

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

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

5. Loamy soils that are less than 20 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 20 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

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

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

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 17, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

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

Soil and Water Features

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

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

The four hydrologic soil groups are:

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

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

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

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

If a soil is assigned to two hydrologic groups in table 18, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

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

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

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

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

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

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

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

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.

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

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

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

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

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*9*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 19 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

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

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

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Hapludalfs (*Hapl*, meaning minimal horizonation, plus *udalf*, the suborder of the Alfisols that has a udic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Hapludalfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, mesic Typic Hapludalfs.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the underlying material can differ within a series.

Soil Series and Their Morphology

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

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*8*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*9*). 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."

Blount Series

The Blount series consists of deep, somewhat poorly drained soils on till plains and moraines. These soils formed in silty material over glacial till. They are slowly permeable or moderately slowly permeable in the solum and slowly permeable in the underlying material. Slopes range from 0 to 3 percent

Blount soils are commonly near Glynwood, Morley, and Pewamo soils. Glynwood and Morley soils are browner in the subsoil than the Blount soils. They are in the higher positions on the landscape. Pewamo soils have a surface layer that is darker than that of the

Blount soils. They are in the lower positions on the landscape.

Typical pedon of Blount silt loam, 0 to 2 percent slopes, in a cultivated field; 1,710 feet north and 147 feet east of the southwest corner of sec. 34, T. 25 N., R. 7 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak medium granular structure; friable; common fine roots; about 4 percent gravel; medium acid; abrupt smooth boundary.

Bt1—9 to 16 inches; dark yellowish brown (10YR 4/4) silty clay loam; many medium distinct gray (10YR 5/1) and many fine faint yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin continuous grayish brown (10YR 5/2) clay films on faces of peds; about 4 percent gravel; strongly acid; clear wavy boundary.

2Bt2—16 to 28 inches; yellowish brown (10YR 5/4) clay; many fine distinct gray (10YR 5/1) and many fine faint yellowish brown (10YR 5/6) mottles; moderate medium angular blocky structure; firm; few fine roots; thin continuous grayish brown (10YR 5/2) clay films on faces of peds; few black (N 2/0) iron and manganese oxide stains and accumulations; about 4 percent gravel; neutral; clear wavy boundary.

2Bt3—28 to 34 inches; brown (10YR 5/3) clay loam; common fine distinct gray (10YR 5/1) and many fine faint yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; few fine roots; thin discontinuous grayish brown (10YR 5/2) clay films on faces of peds; few light gray (10YR 7/1) carbonate coatings; about 5 percent gravel; slight effervescence; mildly alkaline; clear wavy boundary.

2C—34 to 60 inches; brown (10YR 5/3) clay loam; massive; firm; common light gray (10YR 7/1) carbonate coatings; about 5 percent coarse fragments; strong effervescence; moderately alkaline.

The solum is 20 to 40 inches thick. The depth to carbonates is 19 to 38 inches. The silty material is 8 to 19 inches thick.

The Ap horizon has hue of 10YR, value of 4 (6 dry), and chroma of 2 or 3. It is dominantly silt loam or silty clay loam, but the range includes loam. The Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is silty clay loam, silty clay, clay, or clay loam. It is strongly acid to slightly acid in the upper part and neutral or mildly alkaline in the lower part. The C horizon has hue of 10YR, value of 5, and chroma of 3 or 4. It is silty clay loam or clay loam.

Bono Series

The Bono series consists of deep, very poorly drained, slowly permeable soils in depressions on lake plains. These soils formed in lacustrine sediments. Slopes range from 0 to 2 percent.

Bono soils are commonly near Blount, Houghton, and Wallkill soils. Blount soils are browner in the subsoil than the Bono soils. They are in the higher landscape positions. The deep, organic Houghton soils are in the lower landscape positions. Wallkill soils are underlain by organic deposits. They are in the lower areas.

Typical pedon of Bono silty clay, in a cultivated field; 1,355 feet south and 1,660 feet east of the northwest corner of sec. 12, T. 25 N., R. 8 E.

Ap—0 to 11 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; firm; few fine roots; neutral; abrupt smooth boundary.

Bg1—11 to 20 inches; dark gray (10YR 4/1) silty clay; few fine distinct olive brown (2.5Y 4/4) and common medium faint gray (10YR 5/1) mottles; moderate medium angular blocky structure; very firm; few fine roots; thin continuous very dark gray (10YR 3/1) organic coatings on faces of peds; few black (N 2/0) iron and manganese oxide stains and accumulations; neutral; clear wavy boundary.

Bg2—20 to 29 inches; dark gray (10YR 4/1) silty clay; common medium distinct olive brown (2.5Y 4/4) and dark yellowish brown (10YR 4/6) and common medium faint gray (10YR 5/1) mottles; weak medium subangular blocky structure; very firm; few fine roots; thin discontinuous very dark gray (10YR 3/1) organic coatings on faces of peds; few black (N 2/0) iron and manganese oxide stains and accumulations; neutral; clear wavy boundary.

Bg3—29 to 37 inches; gray (10YR 5/1) silty clay; many medium distinct dark yellowish brown (10YR 4/6) and olive gray (5Y 5/2) mottles; weak medium subangular blocky structure; firm; few fine roots; thin discontinuous very dark gray (5Y 3/1) organic coatings on faces of peds; few black (N 2/0) iron and manganese oxide stains and accumulations; neutral; clear wavy boundary.

Bg4—37 to 48 inches; gray (10YR 5/1) clay that has thin strata of clay loam; many medium distinct dark yellowish brown (10YR 4/6) and olive gray (5Y 5/2) mottles; moderate medium subangular blocky structure; firm; thin discontinuous very dark gray (5Y 3/1) organic coatings on faces of peds; neutral; clear wavy boundary.

Bg5—48 to 55 inches; gray (10YR 5/1) silty clay loam that has thin strata of clay loam; many medium distinct dark yellowish brown (10YR 4/6) mottles; weak medium subangular blocky structure; firm; thin discontinuous very dark gray (5Y 3/1) organic coatings on faces of peds; slight effervescence; mildly alkaline; clear wavy boundary.

Cg—55 to 60 inches; gray (10YR 5/1) silty clay loam that has thin strata of clay loam and sandy loam; many coarse distinct dark yellowish brown (10YR 4/6) mottles; massive; firm; strong effervescence; moderately alkaline.

The solum is 40 to 60 inches thick. The A horizon has hue of 10YR, value of 2 or 3 (4 or 5 dry), and chroma of 1 or 2. It is dominantly silty clay, but the range includes silty clay loam. The Bg horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 or 5, and chroma of 1 or 2. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is silty clay loam or silty clay that has thin strata of clay loam, sandy loam, or loam.

Crosby Series

The Crosby series consists of deep, somewhat poorly drained, slowly permeable soils on till plains. These soils formed in silty material over glacial till. Slopes range from 0 to 2 percent.

Crosby soils are commonly near Patton soils. Patton soils have a surface layer that is darker than that of the Crosby soils. They are in the lower landscape positions.

Typical pedon of Crosby silt loam, 0 to 2 percent slopes, in a cultivated field; 454 feet north and 138 feet east of the southwest corner of sec. 33, T. 23 N., R. 6 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; weak medium granular structure; friable; common fine roots; about 2 percent gravel; neutral; abrupt smooth boundary.

Bt1—8 to 12 inches; dark yellowish brown (10YR 4/6) silty clay loam; common fine distinct grayish brown (10YR 5/2) mottles; moderate fine subangular blocky structure; firm; few fine roots; thin continuous dark grayish brown (10YR 4/2) clay films on faces of peds; about 2 percent gravel; strongly acid; clear wavy boundary.

Bt2—12 to 17 inches; dark yellowish brown (10YR 4/6) silty clay loam; many fine distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin continuous dark grayish brown (10YR 4/2) clay films on faces of peds; few black (N 2/0) iron and manganese oxide stains and accumulations; about 2 percent gravel; strongly acid; clear wavy boundary.

2Bt3—17 to 24 inches; dark yellowish brown (10YR 4/4) clay loam; few fine distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin continuous dark grayish brown (10YR 4/2) clay films on faces of peds; few black (N 2/0) iron and manganese oxide stains and accumulations; about 4 percent gravel; medium acid; gradual wavy boundary.

2Bt4—24 to 29 inches; dark yellowish brown (10YR 4/4) clay loam; many fine distinct grayish brown (10YR 5/2) mottles; moderate medium angular blocky structure; firm; few fine roots; thin continuous dark grayish brown (10YR 4/2) clay films on faces of peds; about 4 percent gravel; medium acid; clear wavy boundary.

2Bt5—29 to 35 inches; dark yellowish brown (10YR 4/4) loam; few fine distinct grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; firm; thin discontinuous dark grayish brown (10YR 4/2) clay films on faces of peds; about 4 percent gravel; slight effervescence; mildly alkaline; gradual wavy boundary.

2C1—35 to 45 inches; brown (10YR 5/3) loam; massive; firm; few light gray (10YR 7/2) carbonate coatings; about 4 percent gravel; strong effervescence; moderately alkaline; gradual wavy boundary.

2C2—45 to 60 inches; brown (10YR 5/3) loam; massive; firm; about 4 percent gravel; strong effervescence; moderately alkaline.

The solum is 23 to 40 inches thick. The depth to carbonates is 20 to 36 inches. The silty material is 11 to 18 inches thick.

The Ap horizon has hue of 10YR, value of 4 or 5 (6 or 7 dry), and chroma of 2. It is dominantly silt loam, but the range includes loam. The Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 6. The 2Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. The 2C horizon has hue of 10YR, value of 4 or 5, and chroma of 3.

Fox Series

The Fox series consists of well drained soils on terraces. These soils formed in loamy sediments that are moderately deep over sand and very gravelly coarse sand. Permeability is moderate in the subsoil and rapid or very rapid in the underlying material. Slopes range from 0 to 15 percent.

Fox soils are commonly near Fox Variant, Millgrove, and Ockley soils. Fox Variant soils are underlain by bedrock. Millgrove soils have a surface layer that is darker than that of the Fox soils. They are very poorly drained and are in the lower landscape positions. Ockley soils are deeper to sand and very gravelly coarse sand than the Fox soils.

Typical pedon of Fox silt loam, 0 to 2 percent slopes, in a cultivated field; 260 feet north and 885 feet east of the southwest corner of sec. 14, T. 25 N., R. 7 E.

Ap—0 to 9 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak coarse granular structure; friable; many fine roots; about 10 percent gravel; slightly acid; abrupt smooth boundary.

Bt1—9 to 15 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; friable; few fine roots; thin continuous dark yellowish brown (10YR 3/4) clay films on faces of peds; about 15 percent gravel; medium acid; clear wavy boundary.

Bt2—15 to 26 inches; brown (7.5YR 4/4) gravelly sandy clay loam; moderate medium subangular blocky structure; friable; few fine roots; thin continuous dark yellowish brown (10YR 3/4) clay films on faces of peds; about 25 percent gravel; strongly acid; clear wavy boundary.

Bt3—26 to 32 inches; brown (7.5YR 4/4) gravelly sandy clay loam; moderate fine subangular blocky structure; friable; few fine roots; thin continuous dark yellowish brown (10YR 3/4) clay films on faces of peds; about 25 percent gravel; medium acid; clear wavy boundary.

Bt4—32 to 35 inches; dark reddish brown (5YR 3/3) gravelly sandy clay loam; moderate fine subangular blocky structure; friable; thin continuous dark brown (7.5YR 3/2) clay films on faces of peds; about 25 percent gravel; neutral; abrupt irregular boundary.

2C—35 to 60 inches; yellowish brown (10YR 5/4) very gravelly coarse sand; single grain; loose; about 40 percent gravel; strong effervescence; moderately alkaline.

The thickness of the solum is 24 to 40 inches and coincides with the depth to carbonates. The Ap horizon has hue of 10YR, value of 4 or 5 (6 or 7 dry), and chroma of 3. It is dominantly silt loam, but the range includes loam, sandy loam, and clay loam. The Bt horizon has hue of 5YR, 7.5YR, or 10YR and value and chroma of 3 or 4. It is clay loam, sandy clay loam, silty clay loam, or the gravelly analogs of these textures.

Fox Variant

The Fox Variant consists of moderately deep, well drained, moderately permeable soils on terraces. These soils formed in silty and loamy sediments over bedrock. Slopes range from 1 to 4 percent.

Fox Variant soils are commonly near Fox soils. Fox soils are underlain by sand and very gravelly coarse sand.

Typical pedon of Fox Variant silt loam, 1 to 4 percent slopes, in a cultivated field; 228 feet south and 1,915 feet east of the northwest corner of sec. 15, T. 25 N., R. 7 E.

Ap—0 to 9 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak coarse granular structure; friable; many fine and medium roots; about 2 percent gravel; strongly acid; abrupt smooth boundary.

E—9 to 13 inches; brown (10YR 5/3) silt loam; weak coarse granular structure; friable; few fine roots; about 2 percent gravel; strongly acid; clear wavy boundary.

Bt1—13 to 17 inches; brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few fine roots; thin continuous dark yellowish brown (10YR 3/4) clay films on faces of peds; about 10 percent gravel; neutral; clear wavy boundary.

Bt2—17 to 21 inches; brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few fine roots; thin continuous dark yellowish brown (10YR 3/4) clay films on faces of peds; about 12 percent gravel; neutral; clear wavy boundary.

Bt3—21 to 25 inches; brown (7.5YR 4/4) gravelly clay loam; moderate medium subangular blocky structure; firm; few fine roots; thin continuous dark yellowish brown (10YR 3/4) clay films on faces of peds; about 25 percent gravel; neutral; abrupt wavy boundary.

2R—25 inches; siltstone interbedded with limestone.

The thickness of the solum is 20 to 40 inches and coincides with the depth to bedrock. The Ap horizon has hue of 10YR, value of 4 (6 dry), and chroma of 2 or 3. It is dominantly silt loam, but the range includes loam. The Bt horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 4. It is clay loam, sandy clay loam, or the gravelly analogs of these textures. It is medium acid to neutral.

Glynwood Series

The Glynwood series consists of deep, moderately well drained, slowly permeable soils on till plains and moraines. These soils formed in silty material over glacial till. Slopes range from 2 to 6 percent.

Glynwood soils are commonly near Blount, Hennepin, Morley, and Pewamo soils. Blount soils are grayer in the subsoil than the Glynwood soils. They are in the lower landscape positions. Hennepin and Morley soils are browner in the subsoil than the Glynwood soils. Hennepin soils are in the steeper areas, and Morley soils are in the higher areas. Pewamo soils have a surface layer that is darker than that of the Glynwood soils. They are poorly drained and very poorly drained and are in the lower landscape positions.

Typical pedon of Glynwood silt loam, 2 to 6 percent slopes, eroded, in a cultivated field; 115 feet south and 775 feet west of the northeast corner of sec. 8, T. 25 N., R. 7 E.

Ap—0 to 8 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak medium granular structure; friable; common fine roots; about 20 percent yellowish brown (10YR 5/6) silty clay loam; about 5 percent gravel; slightly acid; abrupt smooth boundary.

Bt1—8 to 12 inches; yellowish brown (10YR 5/6) silty clay loam; common fine distinct grayish brown (10YR 5/2) and few fine faint yellowish brown (10YR 5/8) mottles; weak fine subangular blocky structure; firm; few fine roots; thin continuous brown (10YR 4/3) clay films on faces of peds; about 1 percent gravel; medium acid; clear wavy boundary.

2Bt2—12 to 19 inches; dark yellowish brown (10YR 4/4) clay loam; few fine distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; moderate medium angular blocky structure; firm; few fine roots; thin continuous brown (10YR 4/3) clay films on faces of peds; common black (10YR 2/1) iron and manganese oxide stains and accumulations; about 4 percent gravel; medium acid; gradual wavy boundary.

2Bt3—19 to 25 inches; dark yellowish brown (10YR 4/4) clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin continuous brown (10YR 4/3) clay films on faces of peds; common black (10YR 2/1) iron and manganese oxide stains and accumulations; about 4 percent gravel; neutral; clear wavy boundary.

2Bt4—25 to 31 inches; dark yellowish brown (10YR 4/4) clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; thin discontinuous brown (10YR 4/3) clay films on faces of peds; about 4 percent gravel; slight effervescence; mildly alkaline; clear wavy boundary.

2C1—31 to 45 inches; yellowish brown (10YR 5/4) clay loam; few fine faint yellowish brown (10YR 5/6) mottles; massive; firm; few white (10YR 8/1) carbonate coatings; about 4 percent gravel; strong effervescence; moderately alkaline; gradual wavy boundary.

2C2—45 to 60 inches; yellowish brown (10YR 5/4) clay loam; few fine faint yellowish brown (10YR 5/6) mottles; massive; firm; few white (10YR 8/1) carbonate coatings; about 4 percent gravel; strong effervescence; moderately alkaline.

The solum is 18 to 40 inches thick. The depth to carbonates is 16 to 36 inches. The silty material is 6 to 14 inches thick in all pedons, except for those in severely eroded areas.

The A horizon has hue of 10YR, value of 4 or 5 (6 dry), and chroma of 2 or 3. It is dominantly silt loam or silty clay, but the range includes silty clay loam, clay loam, and loam. The 2Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is silty clay loam, clay loam, silty clay, or clay. It is strongly acid to slightly acid in the upper part and neutral or mildly alkaline in the lower part. The 2C horizon has hue of 10YR, value of 4 to 6, and chroma of 3 or 4.

Hennepin Series

The Hennepin series consists of deep, well drained soils on till plains and moraines. These soils formed in glacial till. Permeability is moderately slow in the subsoil and moderately slow or slow in the underlying material. Slopes range from 30 to 70 percent.

Hennepin soils are commonly near Glynwood and Morley soils. Glynwood and Morley soils have more clay in the subsoil than the Hennepin soils. They are in the less sloping areas.

Typical pedon of Hennepin clay loam, 30 to 70 percent slopes, in a wooded area; 140 feet south and 1,095 feet east of the northwest corner of sec. 19, T. 25 N., R. 8 E.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) clay loam, grayish brown (10YR 5/2) dry; moderate medium granular structure; friable; common medium roots; about 6 percent gravel; slight effervescence; mildly alkaline; abrupt wavy boundary.

Bw—3 to 13 inches; yellowish brown (10YR 5/4) clay loam; weak medium subangular blocky structure; firm; common fine roots; about 6 percent gravel; slight effervescence; mildly alkaline; clear wavy boundary.

C1—13 to 30 inches; brown (10YR 5/3) clay loam; massive; firm; few fine roots; about 6 percent gravel; strong effervescence; moderately alkaline; clear wavy boundary.

C2—30 to 60 inches; brown (10YR 5/3) clay loam; massive; firm; about 6 percent gravel; strong effervescence; moderately alkaline.

The solum is 8 to 20 inches thick. It is neutral to moderately alkaline. The depth to carbonates ranges from 0 to 10 inches.

The A horizon has hue of 10YR, value of 2 or 3 (5 or 6 dry), and chroma of 2. It is dominantly clay loam, but the range includes loam. The Bw horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is clay loam or loam. The C horizon also is clay loam or loam. It has hue of 10YR, value of 4 or 5, and chroma of 3 or 4.

Houghton Series

The Houghton series consists of deep, very poorly drained soils on glacial lake plains. These soils formed in herbaceous organic deposits. Permeability is moderately slow to moderately rapid. Slopes range from 0 to 2 percent.

Houghton soils are commonly near Bono, Pewamo, and Wallkill soils, which are in the higher areas. Bono and Pewamo are deep, mineral soils. Wallkill soils formed in mineral sediments over organic deposits.

Typical pedon of Houghton muck, drained, in a cultivated field; 310 feet south and 990 feet east of the northwest corner of sec. 26, T. 23 N., R. 8 E.

Op—0 to 9 inches; sapric material, black (N 2/0) broken face and rubbed, black (5YR 2/1) dry; about 5 percent fiber, 1 percent rubbed; weak coarse granular structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

Oa1—9 to 17 inches; sapric material, black (N 2/0) broken face and rubbed; about 5 percent fiber, 1 percent rubbed; moderate medium subangular blocky structure; friable; few fine roots; slightly acid; gradual smooth boundary.

Oa2—17 to 27 inches; sapric material, dark reddish brown (5YR 2/2) broken face, black (N 2/0) rubbed; about 5 percent fiber, 1 percent rubbed; weak coarse subangular blocky structure; friable; few fine roots; slightly acid; gradual smooth boundary.

Oa3—27 to 39 inches; sapric material, dark reddish brown (5YR 2/2) broken face, black (N 2/0) rubbed; about 5 percent fiber, 1 percent rubbed; massive; friable; slightly acid; gradual smooth boundary.

Oa4—39 to 47 inches; sapric material, dark reddish brown (5YR 2/2) broken face, black (N 2/0) rubbed; about 25 percent fiber, 5 percent rubbed; massive; friable; slightly acid; gradual smooth boundary.

Oa5—47 to 60 inches; sapric material, dark reddish brown (5YR 2/2) broken face, black (N 2/0) rubbed; about 5 percent fiber, 1 percent rubbed; massive; friable; slightly acid.

The organic material is 60 inches to many feet thick. It is medium acid to mildly alkaline. It either has hue of 10YR, 7.5YR, or 5YR, value of 2 or 3, and chroma of 1 or 2 or is neutral in hue and has value of 2 and chroma of 0. Some pedons have a thin layer of hemic material in the lower part.

Landes Series

The Landes series consists of deep, well drained and moderately well drained soils on flood plains. These soils formed in alluvium. Permeability is moderately rapid or rapid. Slopes range from 0 to 2 percent.

Landes soils are commonly near Sloan soils. Sloan soils have more clay in the subsoil and underlying material than the Landes soils. They are very poorly drained and are in the lower positions on the landscape.

Typical pedon of Landes sandy loam, occasionally flooded, in a cultivated field; 405 feet south and 3,795 feet east of the northwest corner of sec. 28, T. 23 N., R. 9 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; weak medium granular structure; friable; few fine roots; neutral; abrupt smooth boundary.

A—8 to 14 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; moderate medium granular structure; friable; few fine roots; neutral; clear wavy boundary.

Bw1—14 to 21 inches; dark yellowish brown (10YR 3/4) sandy loam; weak coarse subangular blocky structure; friable; few fine roots; common distinct dark brown (10YR 3/3) organic coatings on faces of peds; neutral; clear wavy boundary.

Bw2—21 to 30 inches; brown (10YR 4/3) sandy loam; weak coarse subangular blocky structure; friable; few fine roots; common distinct dark brown (10YR 3/3) organic coatings on faces of peds; neutral; clear wavy boundary.

C1—30 to 39 inches; brown (10YR 4/3) sandy loam; massive; friable; few fine roots; neutral; clear wavy boundary.

C2—39 to 49 inches; dark yellowish brown (10YR 4/4) sandy loam; massive; friable; about 1 percent gravel; strong effervescence; moderately alkaline; gradual wavy boundary.

C3—49 to 57 inches; brown (10YR 4/3) sandy loam; massive; friable; about 2 percent gravel; strong effervescence; moderately alkaline; clear wavy boundary.

C4—57 to 60 inches; brown (10YR 4/3) loamy sand; massive; friable; about 2 percent gravel; strong effervescence; moderately alkaline.

The solum is 25 to 35 inches thick. The A horizon has hue of 10YR, value of 2 or 3 (4 or 5 dry), and chroma of 2 or 3. It is dominantly sandy loam, but the range includes fine sandy loam. The Bw horizon has hue of 10YR, value of 3 to 5, and chroma of 3 or 4. It is sandy loam, loam, or fine sandy loam. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is loamy sand, sandy loam, fine sand, or loam and is stratified in many pedons.

Millgrove Series

The Millgrove series consists of deep, very poorly drained soils on terraces. These soils formed in loamy and gravelly sediments. Permeability is moderate in the subsoil and moderately rapid in the underlying material. Slopes range from 0 to 2 percent.

Millgrove soils are commonly near Fox, Fox Variant, and Ockley soils. The nearby soils are browner in the subsoil than the Millgrove soils. They are well drained and are in the higher areas.

Typical pedon of Millgrove loam, in a cultivated field; 1,280 feet west and 1,195 feet south of the northeast corner of sec. 11, T. 25 N., R. 7 E.

Ap—0 to 11 inches; very dark gray (10YR 3/1) loam, grayish brown (10YR 5/2) dry; weak coarse granular structure; friable; common fine roots; about 2 percent gravel; neutral; abrupt smooth boundary.

Bg—11 to 14 inches; dark gray (10YR 4/1) loam; few fine prominent olive yellow (2.5Y 6/6) mottles; moderate fine subangular blocky structure; friable; few fine roots; about 2 percent gravel; neutral; clear wavy boundary.

Btg1—14 to 18 inches; dark gray (10YR 4/1) clay loam; few fine prominent olive yellow (2.5Y 6/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin continuous very dark grayish brown (10YR 3/2) clay films on faces of peds; about 2 percent gravel; neutral; clear wavy boundary.

Btg2—18 to 24 inches; gray (10YR 5/1) clay loam; common fine prominent olive yellow (2.5Y 6/6) mottles; weak medium subangular blocky structure; firm; few fine roots; thin continuous dark gray (10YR 4/1) clay films on faces of peds; about 5 percent gravel; neutral; clear wavy boundary.

Btg3—24 to 29 inches; gray (10YR 5/1) clay loam; many medium prominent olive yellow (2.5Y 6/6) mottles; weak coarse subangular blocky structure; firm; few fine roots; thin continuous dark gray (10YR 4/1) clay films on faces of peds; about 10 percent gravel; neutral; clear wavy boundary.

Btg4—29 to 33 inches; gray (10YR 5/1) gravelly clay loam; many medium prominent olive yellow (2.5Y 6/6) mottles; weak medium subangular blocky structure; firm; few fine roots; thin continuous dark gray (10YR 4/1) clay films on faces of peds; about 21 percent gravel; neutral; clear wavy boundary.

Btg5—33 to 38 inches; gray (10YR 5/1) gravelly clay loam; many medium prominent olive yellow (2.5Y 6/6) mottles; weak coarse subangular blocky structure; firm; few fine roots; thin continuous dark gray (10YR 4/1) clay films on faces of peds; about 27 percent gravel; neutral; clear wavy boundary.

BCg—38 to 41 inches; dark gray (10YR 4/1) sandy loam; many fine prominent olive yellow (2.5Y 6/6) mottles; weak coarse subangular blocky structure; friable; about 6 percent gravel; neutral; clear wavy boundary.

Cg1—41 to 45 inches; dark gray (10YR 4/1) sandy loam that has strata of loamy sand; many fine prominent olive yellow (2.5Y 6/6) mottles; massive; friable; about 3 percent gravel; neutral; clear wavy boundary.

Cg2—45 to 49 inches; dark gray (10YR 4/1) gravelly sandy loam; many medium prominent olive yellow (2.5Y 6/6) mottles; massive; friable; about 31 percent gravel; slight effervescence; mildly alkaline; clear wavy boundary.

Cg3—49 to 53 inches; dark gray (10YR 4/1) sandy loam that has thin strata of loamy sand; few medium prominent olive yellow (2.5Y 6/6) mottles; massive; friable; about 6 percent gravel; strong effervescence; moderately alkaline; clear wavy boundary.

Cg4—53 to 58 inches; grayish brown (10YR 5/2) loamy sand; many medium prominent olive yellow (2.5Y 6/6) mottles; single grain; loose; about 6 percent gravel; strong effervescence; moderately alkaline; clear wavy boundary.

Cg5—58 to 60 inches; gray (10YR 5/1) fine sandy loam that has thin strata of loamy sand; massive; friable; about 1 percent gravel; strong effervescence; moderately alkaline.

The solum is 30 to 55 inches thick. The Ap horizon has hue of 10YR, value of 2 or 3 (4 or 5 dry), and chroma of 1 or 2. It is dominantly loam, but the range includes silt loam. The Btg horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is clay loam, sandy loam, loam, sandy clay loam, or the gravelly analogs of these textures. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is loam, sandy loam, fine sandy loam, fine sand, loamy sand, or the gravelly analogs of these textures and is stratified.

Morley Series

The Morley series consists of deep, well drained soils on till plains and moraines. These soils formed in glacial till. Permeability is moderately slow in the solum and slow in the underlying material. Slopes range from 6 to 18 percent.

Morley soils are commonly near Blount, Glynwood, Hennepin, and Pewamo soils. Blount and Glynwood soils are lower on the landscape than the Morley soils. Also, Blount soils have a grayer subsoil. Glynwood soils have grayish mottles in the subsoil. Hennepin soils have less clay in the subsoil than the Morley soils. They are in the steeper areas. Pewamo soils have a surface layer that is darker than that of the Morley soils. They are poorly drained and very poorly drained and are in the lower areas.

Typical pedon of Morley clay loam, 6 to 15 percent slopes, eroded, in a cultivated field; 2,200 feet north and 945 feet east of the southwest corner of sec. 28, T. 25 N., R. 6 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) clay loam, pale brown (10YR 6/3) dry; weak coarse granular structure; friable; many fine roots; about 6 percent gravel; slightly acid; abrupt smooth boundary.

Bt1—8 to 13 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium angular blocky structure; firm; few fine roots; thin continuous dark yellowish brown (10YR 3/4) clay films on faces of peds; about 4 percent gravel; medium acid; clear wavy boundary.

Bt2—13 to 19 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium angular blocky structure; firm; few fine roots; thin continuous brown (10YR 4/3) clay films on faces of peds; about 4 percent gravel; neutral; clear wavy boundary.

BC—19 to 24 inches; yellowish brown (10YR 5/4) clay loam; weak medium subangular blocky structure; firm; few fine roots; thin discontinuous dark yellowish brown (10YR 4/4) clay films on faces of peds; about 4 percent gravel; slight effervescence; mildly alkaline; clear wavy boundary.

C1—24 to 30 inches; yellowish brown (10YR 5/4) clay loam; massive; firm; thin discontinuous brown (10YR 4/3) clay films on internal planes; about 4 percent gravel; strong effervescence; moderately alkaline; clear wavy boundary.

C2—30 to 60 inches; yellowish brown (10YR 5/4) clay loam; massive; firm; about 4 percent gravel; strong effervescence; moderately alkaline.

The solum is 20 to 36 inches thick. The depth to carbonates is 12 to 32 inches.

The Ap horizon has hue of 10YR, value of 3 or 4 (5 or 6 dry), and chroma of 2. It is dominantly silty clay loam, clay loam, or silt loam, but the range includes clay and loam. The Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is silty clay loam, silty clay, clay, or clay loam. It is strongly acid to slightly acid in the upper part and neutral or mildly alkaline in the lower part. The C horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4.

Ockley Series

The Ockley series consists of deep, well drained soils on terraces. These soils formed in loamy sediments over sand and very gravelly coarse sand. Permeability is moderate in the subsoil and very rapid in the underlying material. Slopes range from 0 to 2 percent.

Ockley soils are commonly near Fox and Millgrove soils. Fox soils are moderately deep to sand and very gravelly coarse sand. Millgrove soils have a surface layer that is darker than that of the Ockley soils. They are very poorly drained and are in the lower landscape positions.

Typical pedon of Ockley silt loam, 0 to 2 percent slopes, in a cultivated field; 2,570 feet north and 310 feet east of the southwest corner of sec. 29, T. 25 N., R. 7 E.

Ap—0 to 8 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak coarse granular structure; friable; few fine roots; about 4 percent gravel; strongly acid; abrupt smooth boundary.

Bt1—8 to 13 inches; brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few fine roots; thin continuous dark yellowish brown (10YR 3/4) clay films on faces of peds; strongly acid; clear wavy boundary.

Bt2—13 to 18 inches; brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few fine roots; thin continuous dark yellowish brown (10YR 3/4) clay films on faces of peds; strongly acid; clear wavy boundary.

Bt3—18 to 23 inches; brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few fine roots; thin continuous dark reddish brown (5YR 3/4) clay films on faces of peds; about 1 percent gravel; strongly acid; clear wavy boundary.

Bt4—23 to 30 inches; brown (7.5YR 4/4) sandy clay loam; moderate medium subangular blocky structure; firm; few fine roots; thin continuous dark reddish brown (5YR 3/4) clay films on faces of peds; about 1 percent gravel; strongly acid; clear wavy boundary.

Bt5—30 to 39 inches; brown (7.5YR 4/4) sandy loam; moderate medium subangular blocky structure; friable; thin continuous dark reddish brown (5YR 3/4) clay films on faces of peds; about 1 percent gravel; strongly acid; clear wavy boundary.

Bt6—39 to 49 inches; brown (7.5YR 4/4) sandy loam; moderate medium subangular blocky structure; friable; thin continuous dark reddish brown (5YR 3/4) clay films on faces of peds; about 2 percent gravel; strongly acid; clear wavy boundary.

Bt7—49 to 56 inches; brown (7.5YR 4/4) sandy clay loam; weak medium subangular blocky structure; friable; thin continuous dark reddish brown (5YR 3/4) clay films on faces of peds; about 4 percent gravel; slightly acid; clear wavy boundary.

Bt8—56 to 59 inches; dark brown (7.5YR 3/2) gravelly sandy clay loam; weak medium subangular blocky structure; friable; thin continuous dark reddish brown (5YR 3/2) clay films on faces of peds; about 22 percent gravel; slightly acid; abrupt irregular boundary.

C—59 to 60 inches; brown (10YR 5/3) very gravelly coarse sand; single grain; loose; about 43 percent gravel; strong effervescence; moderately alkaline.

The solum is 50 to 72 inches thick. The Ap horizon has hue of 10YR, value of 4 or 5 (6 or 7 dry), and chroma of 3. It is dominantly silt loam, but the range includes loam. The Bt horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 2 to 4. It is clay loam, silty clay loam, sandy clay loam, sandy loam, or the gravelly analogs of these textures. It is very strongly acid to neutral.

Patton Series

The Patton series consists of deep, poorly drained soils on glacial lake plains. These soils formed in silty material over lacustrine sediments. Permeability is moderate in the subsoil and moderately slow in the underlying material. Slopes range from 0 to 2 percent.

Patton soils are commonly near Crosby soils. Crosby soils are browner in the subsoil than the Patton soils. They are in the higher landscape positions.

Typical pedon of Patton silty clay loam, in a cultivated field; 65 feet north and 1,075 feet east of the southwest corner of sec. 35, T. 23 N., R. 6 E.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak coarse granular structure; firm; common fine roots; slightly acid; abrupt smooth boundary.

A—8 to 11 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak coarse granular structure; firm; few fine roots; slightly acid; clear wavy boundary.

Bg1—11 to 17 inches; dark grayish brown (2.5Y 4/2) silty clay loam; common fine distinct dark gray (10YR 4/1) and few fine distinct dark yellowish brown (10YR 4/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin discontinuous very dark grayish brown (2.5Y 3/2) organic coatings on faces of peds; neutral; clear wavy boundary.

Bg2—17 to 22 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine distinct dark gray (10YR 4/1) and few fine distinct dark yellowish brown (10YR 4/6) mottles; weak fine prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; few discontinuous very dark grayish brown (2.5Y 3/2) organic coatings on faces of peds; neutral; clear wavy boundary.

Bg3—22 to 26 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine distinct dark gray (10YR 4/1) and dark yellowish brown (10YR 4/6) mottles; weak fine prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; few black (N 2/0) iron and manganese oxide stains and accumulations; neutral; clear wavy boundary.

Bg4—26 to 32 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium distinct dark gray (10YR 4/1) and many medium distinct dark yellowish brown (10YR 4/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; neutral; clear wavy boundary.

Bg5—32 to 37 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium distinct dark gray (10YR 4/1) and many coarse distinct dark yellowish brown (10YR 4/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; neutral; clear wavy boundary.

Bg6—37 to 43 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine distinct dark gray (10YR 4/1) and many medium distinct dark yellowish brown (10YR 4/6) mottles; weak coarse subangular blocky structure; firm; few fine roots; about 1 percent gravel; neutral; clear wavy boundary.

Cg1—43 to 49 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine distinct dark gray (10YR 4/1) and common coarse distinct dark yellowish brown (10YR 4/6) mottles; massive; firm; about 2 percent gravel; neutral; clear wavy boundary.

2Cg2—49 to 55 inches; grayish brown (2.5Y 5/2) loam; common fine distinct dark gray (10YR 4/1) and many coarse distinct dark yellowish brown (10YR 4/6) mottles; massive; firm; about 2 percent gravel; neutral; clear wavy boundary.

2Cg3—55 to 60 inches; grayish brown (2.5Y 5/2) loam; common fine distinct dark gray (10YR 4/1) and common coarse distinct dark yellowish brown (10YR 4/6) mottles; massive; firm; black (N 2/0) iron and manganese oxide stains and accumulations; about 2 percent gravel; neutral.

The solum is 24 to 45 inches thick. The A horizon has hue of 10YR, value of 3 (5 dry), and chroma of 1 or 2. It is dominantly silty clay loam, but the range includes silt loam. The Bg and C horizons are neutral or mildly alkaline. The Bg horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is silty clay loam, clay loam, silt loam, loam, or sandy loam and is stratified in many pedons.

Pewamo Series

The Pewamo series consists of deep, poorly drained and very poorly drained, moderately slowly permeable soils on till plains and moraines. These soils formed in glacial till. Slopes range from 0 to 2 percent.

Pewamo soils are commonly near Blount, Glynwood, Houghton, Morley, and Wallkill soils. Blount, Glynwood, and Morley soils are browner in the subsoil than the Pewamo soils. They are in the higher landscape positions. The deep, organic Houghton soils are in the lower landscape positions. Wallkill soils also are in the lower positions. They are underlain by organic deposits.

Typical pedon of Pewamo silty clay loam, in a cultivated field; 2,205 feet north and 364 feet west of the southeast corner of sec. 15, T. 24 N., R. 7 E.

Ap—0 to 10 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak coarse granular structure; friable; common fine roots; about 4 percent gravel; slightly acid; abrupt smooth boundary.

Btg1—10 to 19 inches; dark gray (10YR 4/1) silty clay loam; many fine distinct yellowish brown (10YR 5/8) mottles; moderate fine subangular blocky structure; firm; few fine roots; thin continuous very dark gray (10YR 3/1) clay films on faces of peds; about 4 percent gravel; neutral; gradual wavy boundary.

Btg2—19 to 30 inches; gray (10YR 5/1) silty clay loam; many fine distinct yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin continuous grayish brown (2.5Y 5/2) clay films on faces of peds; about 4 percent gravel; neutral; gradual wavy boundary.

Btg3—30 to 39 inches; gray (10YR 5/1) silty clay loam; many medium distinct yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin discontinuous grayish brown (2.5Y 5/2) clay films on faces of peds; about 4 percent gravel; neutral; gradual wavy boundary.

2Btg4—39 to 49 inches; gray (10YR 5/1) clay loam; many medium distinct yellowish brown (10YR 5/8) mottles; weak coarse subangular blocky structure; firm; thin discontinuous grayish brown (2.5Y 5/2) clay films on faces of peds; about 4 percent gravel; neutral; gradual wavy boundary.

2Cg—49 to 60 inches; gray (10YR 5/1) clay loam; many medium distinct yellowish brown (10YR 5/6) mottles; massive; firm; about 4 percent gravel; very slight effervescence; mildly alkaline.

The solum is 45 to 60 inches thick. The A horizon has hue of 10YR, value of 2 or 3 (4 or 5 dry), and chroma of 1 or 2. It is dominantly silty clay loam, but the range includes silt loam. The Btg horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2. It is is slightly acid or neutral. The 2Btg horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. The 2C horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 or 2. It is mildly alkaline or moderately alkaline.

Sloan Series

The Sloan series consists of deep, very poorly drained soils on flood plains. These soils formed in alluvium. Permeability generally is moderate or moderately slow. In the sandy substratum phase, however, it is moderate or moderately slow in the solum and rapid in the underlying material. Slopes range from 0 to 2 percent.

Sloan soils are commonly near Landes soils. Landes soils have less clay in the subsoil and underlying material than the Sloan soils. They are well drained and moderately well drained and are in the higher landscape positions.

Typical pedon of Sloan clay loam, occasionally flooded, in a cultivated field; 84 feet south and 1,360 feet west of the northeast corner of sec. 27, T. 25 N., R. 9 E.

Ap—0 to 10 inches; very dark gray (10YR 3/1) clay loam, grayish brown (10YR 5/2) dry; weak coarse granular structure; firm; few fine roots; about 3 percent gravel; slightly acid; abrupt smooth boundary.

Bg1—10 to 14 inches; dark gray (10YR 4/1) clay loam; common fine prominent yellowish red (5YR 5/8) mottles; moderate medium subangular blocky structure; firm; few fine roots; about 2 percent gravel; neutral; clear wavy boundary.

Bg2—14 to 20 inches; dark gray (10YR 4/1) clay loam; common fine prominent yellowish red (5YR 5/8) mottles; moderate medium subangular blocky structure; firm; few fine roots; about 1 percent gravel; neutral; gradual wavy boundary.

Bg3—20 to 27 inches; gray (5Y 5/1) clay loam; many fine prominent yellowish red (5YR 5/8) mottles; moderate coarse subangular blocky structure; firm; few fine roots; about 2 percent gravel; neutral; gradual wavy boundary.

Bg4—27 to 35 inches; gray (5Y 5/1) clay loam; many fine prominent yellowish red (5YR 5/8) mottles; weak coarse subangular blocky structure; firm; about 1 percent gravel; neutral; gradual wavy boundary.

Cg1—35 to 45 inches; gray (5Y 5/1) clay loam; many fine prominent yellowish red (5YR 5/8) mottles; massive; firm; about 3 percent gravel; neutral; clear wavy boundary.

Cg2—45 to 51 inches; gray (5Y 5/1) loam; many fine prominent yellowish red (5YR 5/8) mottles; massive; friable; about 2 percent gravel; neutral; clear wavy boundary.

Cg3—51 to 60 inches; gray (5Y 5/1) sandy loam that has thin strata of loam; few fine prominent yellowish red (5YR 5/8) mottles; massive; friable; about 1 percent gravel; neutral.

The solum is 25 to 45 inches thick. The Ap horizon has hue of 10YR, value of 2 or 3 (4 or 5 dry), and chroma of 1 or 2. It is dominantly clay loam or silt loam, but the range includes silty clay loam. The Bg and Cg horizons have hue of 10YR or 5Y, value of 4 or 5, chroma of 1 or 2. The Bg horizon is clay loam, silty clay loam, loam, or silt loam. It is slightly acid to mildly alkaline. The Cg horizon is dominantly clay loam, loam, silty clay loam, or sandy loam but is coarse sand in the sandy substratum phase. It is neutral to moderately alkaline.

Wallkill Series

The Wallkill series consists of deep, very poorly drained soils on glacial lake plains. These soils formed in mineral sediments over organic deposits. Permeability is moderate in the mineral material and moderately rapid or rapid in the organic material. Slopes range from 0 to 2 percent.

These soils have less sand in the mineral material than is definitive for the Wallkill series. This difference, however, does not alter the usefulness or behavior of the soils.

Wallkill soils are commonly near Bono, Houghton, and Pewamo soils. The deep, mineral Bono and Pewamo soils are in the higher positions on the landscape. The deep, organic Houghton soils are in the lower positions.

Typical pedon of Wallkill silt loam, undrained, in an idle area; 230 feet north and 1,480 feet west of the southeast corner of sec. 33, T. 24 N., R. 9 E.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silt loam, light gray (10YR 6/1) dry; moderate coarse granular structure; friable; many fine roots; neutral; abrupt smooth boundary.

Bg—9 to 23 inches; very dark gray (10YR 3/1) silt loam that has very thin strata of grayish brown (10YR 5/2) loam; few fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; many fine roots; neutral; clear wavy boundary.

Cg—23 to 30 inches; very dark grayish brown (10YR 3/2) silt loam that has very thin strata of grayish brown (10YR 5/2) loam; few fine distinct gray (10YR 5/1) mottles; massive; friable; few fine roots; neutral; gradual wavy boundary.

2Oa1—30 to 34 inches; sapric material, dark brown (7.5YR 3/2) broken face, black (N 2/0) rubbed; about 25 percent fiber, 5 percent rubbed; moderate medium subangular blocky structure; friable; medium acid; gradual wavy boundary.

2Oa2—34 to 50 inches; sapric material, dark brown (7.5YR 3/2) broken face, black (N 2/0) rubbed; about 25 percent fiber, 5 percent rubbed; massive; friable; slightly acid; gradual wavy boundary.

2Oa3—50 to 60 inches; sapric material, dark brown (7.5YR 3/2) broken face, black (N 2/0) rubbed; about 25 percent fiber, 5 percent rubbed; massive; friable; neutral.

The mineral material is 16 to 40 inches thick. The A horizon has hue of 10YR, value of 3 or 4 (5 or 6 dry), and chroma of 1 or 2. It is dominantly silt loam, but the range includes loam. The Bg and Cg horizons have hue of 10YR, value of 3 to 5, and chroma of 1 or 2. They are silt loam, silty clay loam, or loam and are stratified. They are slightly acid or neutral. The 2Oa horizon has hue of 10YR, 7.5YR, or 5YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. It is dominantly sapric material, but the range includes hemic material.

Formation of the Soils

This section relates the major factors of soil formation to the soils in the county. It also describes the processes of soil formation.

Factors of Soil Formation

Soils form through the processes that act on deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material; the climate under which the soil material accumulated and has existed since accumulation; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time that the forces of soil formation have acted on the soil material.

The parent material affects the kind of soil profile that forms and, in extreme cases, determines it almost entirely. Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of glacial deposits and slowly change it into a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. Finally, time is needed for the transformation of the parent material into a soil. Some time is always required for the differentiation of soil horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effects of any one factor unless conditions are specified for the other four.

Parent Material

Parent material is the unconsolidated mass in which a soil forms. It determines the limits of the chemical and mineralogical composition of the soil. The parent materials in Grant County were deposited by glaciers or by meltwater from the glaciers. Some of these materials were reworked and redeposited by the subsequent actions of water and wind. The glaciers covered the county about 12,000 to 15,000 years ago. Although the parent materials are of common glacial origin, their properties vary greatly, sometimes within small areas, depending on how the materials were deposited. The dominant parent materials in Grant County are glacial till, outwash sediments, lacustrine sediments, alluvium, and organic deposits.

Glacial till is material laid down directly by glaciers with a minimum of water action. It consists of particles of different sizes that are mixed together. The small pebbles in glacial till have sharp corners, indicating that they have not been worn by water. The glacial till in Grant County is calcareous, firm loam or clay loam. Morley and Pewamo are examples of soils that formed in glacial till. These soils typically are moderately fine textured and fine textured and have well developed structure.

The glacial till northeast of the Mississinewa River is different from that in the southwestern part of the county. The difference is reflected in the soils that formed in the till. The content of clay in the C and Bt horizons of the soils in the northeastern part of the county is 5 to 10 percent higher than that in the C and Bt horizons of the soils in the southwestern part.

Outwash sediments were deposited by running water from melting glaciers. The size of the particles that make up outwash varies according to the velocity of the water that carried the material. When the water slowed down, the coarser particles were deposited. Finer particles, such as very fine sand, silt, and clay, were carried farther by the more slowly moving water. Outwash sediments generally occur as layers of similar-size particles, such as loamy sand, sand, and gravelly sand. Fox soils are an example of soils that formed in outwash sediments.

Lacustrine sediments were deposited from still, or ponded, glacial meltwater. Because the coarser fragments dropped out of moving water as outwash, only the finer particles, such as very fine sand, silt, and clay, remained to settle out in still water. Lacustrine sediments are silty or clayey. The soils in Grant County that formed in lacustrine sediments typically are moderately fine textured and fine textured. Bono soils are an example.

Alluvium was recently deposited by floodwater along present streams. This material varies in texture, depending on the speed of the water from which it was deposited. The alluvium deposited along a swift stream, such as the Mississinewa River, is coarser textured than that deposited along a slow, sluggish stream, such as Black Creek. Landes and Sloan are examples of soils that formed in alluvium.

Organic deposits are accumulations of plant remains. After the glaciers withdrew from the survey area, water was left standing in depressions on outwash plains, lake plains, and till plains. Grasses and sedges growing around the edge of these lakes died, and their remains fell to the bottom. Because of wetness the plant remains did not decompose but remained around the edge of the lakes. Later, water-tolerant trees grew in the areas. As these trees died, their remains became part of the organic accumulation. The lakes were eventually filled with organic material, which developed into muck and peat. In some areas the plant remains subsequently decomposed. In other areas the material has changed little since deposition. Houghton soils are an example of soils that formed in organic deposits.

Climate

Climate helps to determine the kind of plant and animal life on and in the soil, the amount of water available for the weathering of minerals and the translocation of soil material, and the rate of chemical reactions in the soil. These influences are important, but they affect large areas rather than relatively small areas, such as a county.

The climate in Grant County is cool and humid. It is presumably similar to the climate under which the soils formed. The soils in Grant County differ from the soils that formed under a dry, warm climate and from those that formed under a hot, moist climate. The climate is uniform throughout the county. More detailed information about the climate is available under the heading "General Nature of the County."

Plant and Animal Life

Plants have been the principal organisms influencing the soils in Grant County. Bacteria, fungi, and earthworms also have affected soil formation. The chief contribution of plant and animal life to soil formation is the addition of organic matter and nitrogen to the soil. The kind of organic material on and in the soil depends on the kinds of native plants that grew on the soil. The remains of these plants accumulated on the surface, decayed, and eventually became organic matter. The roots of the plants provided channels for the downward movement of water through the soil and added organic matter as they decayed. Bacteria helped to break down the organic matter into plant nutrients.

The native vegetation in Grant County was mainly deciduous trees. Differences in natural soil drainage and minor variations in the kind of parent material affected the composition of the forest species. In general, the well drained upland soils, such as Morley soils, supported walnut, ash, and beech. The wet soils primarily supported maple, ash, and sycamore. In a few wet areas, moss contributed substantially to the accumulation of organic matter. Bono and Pewamo soils formed under wet conditions and contain a considerable amount of organic matter. Soils that formed dominantly under forest vegetation generally have less organic matter than soils that formed dominantly under grasses.

Relief

Relief has markedly affected the soils in Grant County through its effect on natural drainage, runoff, erosion, plant cover, and soil temperature. Slopes range from 0 to 70 percent. Runoff is most rapid on the steeper slopes. Water is temporarily ponded in low areas.

Natural soil drainage in the county ranges from well drained on ridgetops to very poorly drained in depressions. Through its effect on aeration of the soil, drainage determines the color of the soil. Water and air move freely through well drained soils but slowly through very poorly drained soils. In Fox and other well drained, well aerated soils, the iron compounds that give most soils their color are brightly colored and oxidized. Bono and other poorly aerated, very poorly drained soils are dull gray and mottled.

Time

Time, usually a long time, is required for the processes of soil formation to form distinct horizons. Differences in the length of time that the parent material has been in place are commonly reflected in the degree of profile development. Some soils form rapidly. Others form slowly.

The soils in the county range from young to mature. The glacial deposits in which many of the soils formed have been exposed to the soil-forming processes long enough for the development of distinct horizons. Some soils, however, have not been in place long enough for distinct horizons to develop. Landes soils are an example of young soils that formed in alluvial sediments. They have weakly developed horizons.

Blount and Crosby soils show the effect of time on the leaching of carbonates. Before soil formation began, the parent material of these soils had about the same content of lime as is currently in the C horizon. Lime has been leached to a depth of about 20 to 40 inches in these soils.

Processes of Soil Formation

Several processes have been involved in the formation of the soils in Grant County. These processes are the accumulation of organic matter; the dissolution, transfer, and removal of calcium carbonates and bases; the liberation and translocation of silicate clay minerals; and the reduction and transfer of iron. In most soils more than one of these processes have helped to differentiate horizons.

Some organic matter has accumulated in the surface layer of all the soils in the county. The organic matter content of some soils is low, but that of others is high. Generally, the soils that have the most organic matter, such as Bono and Pewamo soils, have a black or very dark gray surface layer.

Carbonates and bases have been leached from the upper horizons of nearly all the soils in the county. Leaching probably preceded the translocation of silicate clay minerals. Nearly all of the carbonates and some of the bases have been leached from the A and B horizons of most well drained soils. Even in the wettest soils, some leaching is indicated by the absence of carbonates and by an acid or neutral reaction. Leaching of wet soils is slow because of a high water table or the slow movement of water through the profile.

Silicate clays accumulate in pores and on the faces of the structural units along which water moves. The leaching of bases and the translocation of silicate clays are among the more important processes of horizon differentiation in the county. Blount soils are an example of soils in which translocated silicate clays in the form of clay films have accumulated in the Bt horizon.

Gleying, or the reduction and transfer of iron, has occurred in all of the very poorly drained to somewhat poorly drained soils in the county. In the naturally wet soils, this process has significantly affected horizon differentiation. A gray color in the subsoil indicates the reduction and redistribution of iron oxides. Reduction is commonly accompanied by some transfer of the iron, either from upper horizons to lower ones or completely out of the profile. Mottles, which are in some horizons, indicate the segregation of iron.

References

(1) American Association of State Highway and Transportation Officials. 1982. Standard specifications for highway materials and methods of sampling and testing. Ed. 13, 2 vols., illus.

(2) American Geological Institute. 1962. Dictionary of geological terms. 545 pp.

(3) American Society for Testing and Materials. 1985. Standard test method for classification of soils for engineering purposes. ASTM Stand. D 2487.

(4) Brant and Fuller. 1886. History of Grant County, Indiana. 944 pp.

(5) Hurst, Lewis A., and others. 1917. Soil survey of Grant County, Indiana. U.S. Dep. Agric., Bur. of Soils, 36 pp., illus.

(6) Marion Area Chamber of Commerce. 1981. Community profile '81. 4 pp.

(7) Thornbury, William D. 1969. Principles of geomorphology. 594 pp., illus.

(8) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. (Revision available as a directive in the State Office of the Soil Conservation Service at Indianapolis, Indiana)

(9) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

(10) United States Department of Commerce, Bureau of the Census. 1977. 1974 census of agriculture—Indiana state and county data. Vol. 1, Part 14.

Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

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.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedding system. A drainage system made by plowing, grading, or otherwise shaping the surface of a flat field. It consists of a series of low ridges separated by shallow, parallel dead furrows.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

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, subsurface. Removal of excess ground water through buried drains installed within the soil profile. The drains collect the water and convey it to a gravity or pump outlet.

Drainage, surface. Runoff, or surface flow of water, from an area.

End moraine. See Terminal moraine.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

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.

Fine textured soil. Sandy clay, silty clay, and 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.

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.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

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, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

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.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor filter (in tables). Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4

Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

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 ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Sedimentary peat. See Coprogenous earth.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

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.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from soil blowing 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.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Underlying material. The part of the soil below the solum.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-74 at Marion, Indiana)

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	32.7	15.5	24.1	61	-14	13	1.61	0.78	2.32	5	5.1
February---	35.8	17.5	26.7	62	-10	7	1.89	.92	2.72	4	6.5
March------	46.1	26.3	36.2	78	4	98	2.99	1.66	4.16	7	4.8
April------	60.0	37.1	48.6	84	20	266	3.81	1.95	5.42	8	1.5
May--------	71.8	47.8	59.8	91	29	614	3.87	2.59	5.03	8	.0
June-------	81.4	57.3	69.3	96	41	879	4.16	2.12	5.93	7	.0
July-------	84.3	61.0	72.7	96	46	1,014	4.72	2.28	6.83	7	.0
August-----	82.9	58.3	70.6	95	42	949	3.11	2.30	3.85	6	.0
September--	77.5	51.3	64.4	94	33	732	3.02	.79	4.79	5	.0
October----	65.6	39.9	52.7	85	22	398	2.37	.80	3.66	5	.1
November---	48.6	30.3	39.5	72	10	77	2.51	1.51	3.39	6	1.8
December---	37.8	22.1	30.0	64	-5	21	2.32	.82	3.55	6	5.3
Yearly:											
Average--	60.4	38.7	49.6	---	---	---	---	---	---	---	---
Extreme--	---	---	---	98	-14	---	---	---	---	---	---
Total----	---	---	---	---	---	5,068	36.38	28.26	41.48	74	25.1

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1951-74 at Marion, Indiana)

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. 17	May 3	May 18
2 years in 10 later than--	Apr. 12	Apr. 27	May 12
5 years in 10 later than--	Apr. 3	Apr. 16	May 3
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 21	Oct. 9	Sept. 26
2 years in 10 earlier than--	Oct. 25	Oct. 14	Oct. 2
5 years in 10 earlier than--	Nov. 2	Oct. 24	Oct. 12

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-74 at Marion, Indiana)

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	193	168	144
8 years in 10	200	175	150
5 years in 10	213	190	161
2 years in 10	225	204	173
1 year in 10	232	212	179

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
BhA	Blount silt loam, 0 to 2 percent slopes	43,250	16.3
BkB2	Blount silty clay loam, 1 to 3 percent slopes, eroded	10,100	3.8
Bn	Bono silty clay	2,100	0.8
CuA	Crosby silt loam, 0 to 2 percent slopes	1,250	0.5
FsA	Fox silt loam, 0 to 2 percent slopes	2,400	0.9
FsB2	Fox silt loam, 2 to 6 percent slopes, eroded	2,250	0.9
FtC3	Fox clay loam, 6 to 15 percent slopes, severely eroded	375	0.1
FvB	Fox Variant silt loam, 1 to 4 percent slopes	251	0.1
GrB2	Glynwood silt loam, 2 to 6 percent slopes, eroded	24,000	9.0
GsB3	Glynwood silty clay, 2 to 6 percent slopes, severely eroded	43,750	16.5
HeG	Hennepin clay loam, 30 to 70 percent slopes	1,000	0.4
Ht	Houghton muck, drained	780	0.3
Lc	Landes sandy loam, occasionally flooded	2,100	0.8
Mg	Millgrove loam	910	0.3
MvC	Morley silt loam, 6 to 12 percent slopes	920	0.3
MvD	Morley silt loam, 12 to 18 percent slopes	540	0.2
MwC2	Morley clay loam, 6 to 15 percent slopes, eroded	2,050	0.8
MxC3	Morley clay, 6 to 15 percent slopes, severely eroded	5,060	1.9
OcA	Ockley silt loam, 0 to 2 percent slopes	950	0.4
Pg	Patton silty clay loam	3,650	1.4
Pw	Pewamo silty clay loam	98,500	37.1
Py	Pits	360	0.1
Sn	Sloan clay loam, occasionally flooded	5,600	2.1
St	Sloan silt loam, sandy substratum, occasionally flooded	1,150	0.4
Ud	Udorthents, loamy	830	0.3
UfB	Urban land-Fox complex, 1 to 6 percent slopes	1,200	0.5
UhB	Urban land-Glynwood complex, 2 to 6 percent slopes	2,650	1.0
UmC	Urban land-Morley complex, 6 to 15 percent slopes	630	0.2
Ut	Urban land-Pewamo complex	5,100	1.9
Wa	Wallkill silt loam, undrained	255	0.1
	Water areas less than 40 acres in size	1,550	0.6
	Total	265,511	100.0

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
BhA	Blount silt loam, 0 to 2 percent slopes (where drained)
BkB2	Blount silty clay loam, 1 to 3 percent slopes, eroded (where drained)
Bn	Bono silty clay (where drained)
CuA	Crosby silt loam, 0 to 2 percent slopes (where drained)
FsA	Fox silt loam, 0 to 2 percent slopes
FsB2	Fox silt loam, 2 to 6 percent slopes, eroded
FvB	Fox Variant silt loam, 1 to 4 percent slopes
GrB2	Glynwood silt loam, 2 to 6 percent slopes, eroded
Lc	Landes sandy loam, occasionally flooded
Mg	Millgrove loam (where drained)
OcA	Ockley silt loam, 0 to 2 percent slopes
Pg	Patton silty clay loam (where drained)
Pw	Pewamo silty clay loam (where drained)
Sn	Sloan clay loam, occasionally flooded (where drained)
St	Sloan silt loam, sandy substratum, occasionally flooded (where drained)

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Corn	Soybeans	Winter wheat	Alfalfa-bromegrass hay	Tall fescue
		Bu	Bu	Bu	Tons	AUM*
BhA----- Blount	IIw	106	35	48	4.3	8.6
BkB2----- Blount	IIe	102	34	46	4.1	8.2
Bn----- Bono	IIIw	115	38	40	4.2	8.4
CuA----- Crosby	IIw	110	37	50	3.4	6.8
FsA----- Fox	IIs	95	32	45	4.5	9.0
FsB2----- Fox	IIe	92	29	40	4.2	8.4
FtC3----- Fox	IVe	70	23	35	3.8	7.6
FvB----- Fox Variant	IIe	90	32	40	3.0	6.0
GrB2----- Glynwood	IIIe	95	30	35	4.0	8.0
GsB3----- Glynwood	IIIe	70	25	30	3.5	7.0
HeG----- Hennepin	VIIe	---	---	---	1.2	2.4
Ht----- Houghton	IIIw	115	34	---	---	---
Lc----- Landes	IIw	80	27	34	3.0	6.0
Mg----- Millgrove	IIw	130	50	50	5.0	10.0
MvC----- Morley	IIIe	100	34	46	4.2	8.4
MvD----- Morley	IVe	90	30	41	3.7	7.4
MwC2----- Morley	IIIe	80	28	32	4.0	8.0
MxC3----- Morley	IVe	65	23	26	3.6	7.2
OcA----- Ockley	I	110	38	44	3.6	7.2

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Winter wheat	Alfalfa-bromegrass hay	Tall fescue
		Bu	Bu	Bu	Tons	AUM*
Pg------------------------ Patton	IIw	150	52	56	5.6	11.2
Pw------------------------ Pewamo	IIw	130	46	60	5.0	10.0
Py**. Pits						
Sn------------------------ Sloan	IIIw	126	42	45	5.0	10.0
St------------------------ Sloan	IIIw	120	42	45	4.6	9.2
Ud. Udorthents						
UfB. Urban land-Fox						
UhB. Urban land-Glynwood						
UmC. Urban land-Morley						
Ut. Urban land-Pewamo						
Wa------------------------ Wallkill	Vw	---	---	---	---	---

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--CAPABILITY CLASSES AND SUBCLASSES

(Miscellaneous areas are excluded. Absence of an entry indicates no acreage)

Class	Total acreage	Major management concerns (Subclass)			
		Erosion (e)	Wetness (w)	Soil problem (s)	Climate (c)
		Acres	Acres	Acres	Acres
I	950	---	---	---	---
II	164,661	12,601	149,660	2,400	---
III	80,350	70,720	9,630	---	---
IV	5,975	5,975	---	---	---
V	255	---	255	---	---
VI	---	---	---	---	---
VII	1,000	1,000	---	---	---
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*	
BhA, BkB2: Blount	3C	Slight	Slight	Severe	Severe	White oak	65	48	Eastern white pine, red pine, yellow-poplar.
						Northern red oak	65	48	
						Green ash	---	---	
						Bur oak	---	---	
						Pin oak	---	---	
Bn: Bono	4W	Slight	Severe	Severe	Slight	Pin oak	80	62	Red maple, eastern cottonwood, American sycamore, pin oak, green ash, swamp white oak, silver maple.
						Swamp white oak	---	---	
						Green ash	---	---	
						Red maple	---	---	
						Eastern cottonwood	---	---	
						Black cherry	---	---	
CuA: Crosby	4A	Slight	Slight	Slight	Slight	White oak	75	57	Eastern white pine, northern red oak, white ash, red maple, yellow-poplar, American sycamore.
						Pin oak	85	67	
						Yellow-poplar	85	81	
						Northern red oak	75	57	
FsA, FsB2, FtC3: Fox	4A	Slight	Slight	Slight	Slight	Northern red oak	80	62	Yellow-poplar, white ash, eastern white pine, red pine.
						White oak	---	---	
						Sugar maple	---	---	
FvB: Fox Variant	4A	Slight	Slight	Slight	Slight	Northern red oak	80	62	Yellow-poplar, white ash, eastern white pine, red pine, American sycamore.
						White oak	---	---	
						Sugar maple	---	---	
GrB2, GsB3: Glynwood	4C	Slight	Slight	Moderate	Moderate	Northern red oak	80	62	Austrian pine, yellow-poplar, green ash, red maple, black oak, American sycamore, eastern cottonwood.
						Black oak	80	62	
						White oak	80	62	
						Red maple	---	---	
						Slippery elm	---	---	
						Black cherry	---	---	
						White ash	---	---	

See footnote at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
HeG Hennepin	5R	Severe	Severe	Slight	Slight	Northern red oak White oak	85 ---	67 ---	Northern red oak, white oak, green ash, black walnut, eastern white pine, red pine.
Ht Houghton	2W	Slight	Severe	Severe	Severe	White ash Red maple Black willow Quaking aspen Silver maple	51 51 --- 56 76	35 33 --- 56 30	
Lc Landes	7A	Slight	Slight	Slight	Slight	Yellow-poplar Eastern cottonwood American sycamore Sweetgum Green ash	95 105 --- --- ---	98 141 --- --- ---	Sugar maple, eastern cottonwood, yellow-poplar, American sycamore, green ash, black walnut, eastern white pine.
Mg Millgrove	5W	Slight	Severe	Severe	Severe	Pin oak Northern red oak Swamp white oak Red maple Eastern cottonwood Black cherry Green ash	86 80 85 --- --- --- ---	68 62 67 --- --- --- ---	Swamp white oak, eastern cottonwood, green ash, pin oak, red maple, silver maple, American sycamore.
MvC Morley	4A	Slight	Slight	Slight	Slight	White oak Northern red oak Yellow-poplar Black walnut Bur oak Shagbark hickory	80 80 90 --- --- ---	62 62 90 --- --- ---	White oak, black walnut, green ash, eastern white pine, red pine, white spruce.
MvD Morley	4R	Moderate	Moderate	Slight	Slight	White oak Northern red oak Yellow-poplar Black walnut Bur oak Shagbark hickory	80 80 90 --- --- ---	62 62 90 --- --- ---	White oak, black walnut, green ash, eastern white pine, red pine, white spruce.

See footnote at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Volume*	Trees to plant
MwC2, MxC3: Morley	4A	Slight	Slight	Slight	Slight	White oak	80	62	White oak, black walnut, green ash, eastern white pine, red pine, white spruce.
						Northern red oak	80	62	
						Yellow-poplar	90	90	
						Black walnut	---	---	
						Bur oak	---	---	
						Shagbark hickory	---	---	
OcA: Ockley	5A	Slight	Slight	Slight	Slight	White oak	90	72	Eastern white pine, red pine, white ash, yellow-poplar, black walnut.
						Northern red oak	90	72	
						Yellow-poplar	98	104	
						Sweetgum	76	70	
Pg: Patton	5W	Slight	Severe	Moderate	Moderate	Pin oak	85	67	Eastern white pine, red maple, white ash.
						White oak	75	57	
						Sweetgum	80	79	
						Northern red oak	75	57	
Pw: Pewamo	5W	Slight	Severe	Moderate	Moderate	Pin oak	90	72	White ash, eastern white pine, red maple, green ash.
						Swamp white oak	---	---	
						Red maple	71	44	
						White ash	71	67	
						Eastern cottonwood	98	---	
						Green ash	---	---	
Sn: Sloan	5W	Slight	Severe	Severe	Severe	Pin oak	86	68	Red maple, green ash, eastern cottonwood, pin oak, swamp white oak, silver maple, American sycamore.
						Swamp white oak	---	---	
						Red maple	---	---	
						Green ash	---	---	
						Eastern cottonwood	---	---	
St: Sloan	5W	Slight	Severe	Severe	Severe	Pin oak	86	68	Pin oak, American sycamore, eastern cottonwood, red maple, green ash, swamp white oak, silver maple.
						Green ash	---	---	
						Red maple	---	---	
						Swamp white oak	---	---	
						Eastern cottonwood	---	---	
Wa: Wallkill	3W	Slight	Severe	Severe	Severe	Pin oak	65	48	Red maple, green ash, eastern cottonwood, pin oak, swamp white oak, sweetgum.
						Red maple	51	33	
						White ash	52	30	
						Quaking aspen	56	56	
						Black willow	---	---	
						Silver maple	---	---	

* Volume is the yield in cubic feet per acre per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
BhA, BkB2: Blount	---	American cranberrybush, Tatarian honeysuckle, Amur honeysuckle, arrowwood, Amur privet, Washington hawthorn, eastern redcedar.	Osageorange, green ash, Austrian pine.	Eastern white pine	---
Bn: Bono	---	American cranberrybush, silky dogwood, Amur privet, Amur honeysuckle.	Northern white-cedar, Austrian pine, blue spruce, white fir, Washington hawthorn.	Eastern white pine, Norway spruce.	---
CuA: Crosby	---	Arrowwood, eastern redcedar, Washington hawthorn, Amur honeysuckle, American cranberrybush, Amur privet, Tatarian honeysuckle.	Austrian pine, green ash, osageorange.	Eastern white pine, pin oak.	---
FsA, FsB2, FtC3: Fox	Siberian peashrub	Autumn-olive, Amur honeysuckle, eastern redcedar, radiant crabapple, Washington hawthorn, lilac, Tatarian honeysuckle.	Eastern white pine, Austrian pine, red pine, jack pine.	---	---
FvB: Fox Variant	Siberian peashrub	Eastern redcedar, radiant crabapple, Washington hawthorn, autumn-olive, Amur honeysuckle, lilac, Tatarian honeysuckle.	Eastern white pine, Austrian pine, red pine, jack pine.	---	---
GrB2, GsB3: Glynwood	---	Amur honeysuckle, Washington hawthorn, Amur privet, arrowwood, eastern redcedar, Tatarian honeysuckle, American cranberrybush.	Austrian pine, green ash, osageorange.	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	8-15	16-25	26-35	>35
HeG: Hennepin	Siberian peashrub, Tatarian honeysuckle.	Eastern redcedar, osageorange, Russian-olive, jack pine, Washington hawthorn, silky dogwood, Amur privet, American cranberrybush.	Honeylocust, northern catalpa.	---	---
Ht: Houghton	Common ninebark, whitebelle honeysuckle.	Amur honeysuckle, Amur privet, silky dogwood, nannyberry viburnum, Tatarian honeysuckle.	Tall purple willow	Golden willow, black willow.	Imperial Carolina poplar.
Lc: Landes	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Austrian pine, white fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.
Mg: Millgrove	---	Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet.	Washington hawthorn, white fir, blue spruce, northern white-cedar, Austrian pine, Norway spruce.	Eastern white pine	Pin oak.
MvC, MvD, MwC2, MxC3: Morley	---	Amur honeysuckle, Washington hawthorn, eastern redcedar, Amur privet, arrowwood, American cranberrybush, Tatarian honeysuckle.	Austrian pine, green ash, osageorange.	Eastern white pine, pin oak.	---
OcA: Ockley	---	Amur honeysuckle, American cranberrybush, Amur privet, silky dogwood.	White fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.
Pg: Patton	---	Amur privet, silky dogwood, American cranberrybush, Amur honeysuckle.	White fir, northern white-cedar, blue spruce, Austrian pine, Washington hawthorn, Norway spruce.	Eastern white pine	Pin oak.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Pw: Pewamo	---	Amur honeysuckle, silky dogwood, Amur privet, American cranberrybush.	Northern white-cedar, Norway spruce, Austrian pine, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
Py*. Pits					
Sn, St: Sloan	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Northern white-cedar, Norway spruce, Austrian pine, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
Ud. Udorthents					
UfB*: Urban land.					
Fox	Siberian peashrub	Autumn-olive, Amur honeysuckle, eastern redcedar, radiant crabapple, Washington hawthorn, lilac, Tatarian honeysuckle.	Eastern white pine, Austrian pine, red pine, jack pine.	---	---
UhB*: Urban land.					
Glynwood	---	Amur honeysuckle, Washington hawthorn, Amur privet, arrowwood, eastern redcedar, Tatarian honeysuckle, American cranberrybush.	Austrian pine, green ash, osageorange.	Eastern white pine	---
UmC*: Urban land.					

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
UmC*:					
Morley	---	Amur honeysuckle, Washington hawthorn, eastern redcedar, Amur privet, arrowwood, American cranberrybush, Tatarian honeysuckle.	Austrian pine, green ash, osageorange.	Eastern white pine, pin oak.	---
Ut*:					
Urban land.					
Pewamo	---	Amur honeysuckle, silky dogwood, Amur privet, American cranberrybush.	Northern white-cedar, Norway spruce, Austrian pine, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
Wa Wallkill	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, northern white-cedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
BhA, BkB2: Blount	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Bn: Bono	Severe: ponding, too clayey.	Severe: ponding, too clayey.	Severe: too clayey, ponding.	Severe: ponding, too clayey.	Severe: ponding, too clayey.
CuA: Crosby	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
FsA, FsB2: Fox	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight	Moderate: small stones.
FtC3: Fox	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight	Moderate: slope, small stones.
FvB: Fox Variant	Slight	Slight	Moderate: slope, depth to rock.	Slight	Moderate: depth to rock.
GrB2, GsB3: Glynwood	Moderate: percs slowly, wetness.	Moderate: wetness, percs slowly.	Moderate: wetness, slope, percs slowly.	Moderate: wetness.	Slight.
HeG: Hennepin	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Ht: Houghton	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.
Lc: Landes	Severe: flooding.	Slight	Slight	Slight	Moderate: droughty, flooding.
Mg: Millgrove	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
MvC: Morley	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
MvD: Morley	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
MwC2: Morley	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
MxC3: Morley	Severe: too clayey.	Severe: too clayey.	Severe: slope, too clayey.	Severe: too clayey.	Severe: too clayey.
OcA: Ockley	Slight	Slight	Moderate: small stones.	Slight	Slight.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Pg: Patton	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Pw: Pewamo	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Py*. Pits					
Sn, St: Sloan	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Ud. Udorthents					
UfB*: Urban land.					
Fox	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight	Moderate: small stones.
UhB*: Urban land.					
Glynwood	Moderate: percs slowly, wetness.	Moderate: wetness, percs slowly.	Moderate: wetness, slope, percs slowly.	Moderate: wetness.	Slight.
UmC*: Urban land.					
Morley	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
Ut*: Urban land.					
Pewamo	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Wa: Wallkill	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, erodes easily.	Severe: ponding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
BhA----------------- Blount	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
BkB2---------------- Blount	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Bn------------------ Bono	Fair	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
CuA----------------- Crosby	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
FsA, FsB2, FtC3----- Fox	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
FvB----------------- Fox Variant	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
GrB2, GsB3---------- Glynwood	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
HeG----------------- Hennepin	Very poor.	Poor	Good	Good	Fair	Very poor.	Very poor.	Poor	Good	Very poor.
Ht------------------ Houghton	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Lc------------------ Landes	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Mg------------------ Millgrove	Fair	Fair	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
MvC----------------- Morley	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
MvD----------------- Morley	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
MwC2, MxC3---------- Morley	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
OcA----------------- Ockley	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Pg------------------ Patton	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
Pw------------------ Pewamo	Good	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
Py*. Pits										
Sn, St-------------- Sloan	Fair	Fair	Fair	Poor	Poor	Good	Good	Fair	Poor	Good.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Ud. Udorthents										
UfB*: Urban land.										
Fox	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
UhB*: Urban land.										
Glynwood	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
UmC*: Urban land.										
Morley	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Ut*: Urban land.										
Pewamo	Good	Fair	Fair	Good	Good	Good	Good	Fair	Good	Good.
Wa: Wallkill	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
BhA, BkB2: Blount	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
Bn: Bono	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding, too clayey.
CuA: Crosby	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
FsA: Fox	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Moderate: frost action, shrink-swell.	Moderate: small stones.
FsB2: Fox	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, slope.	Moderate: frost action, shrink-swell.	Moderate: small stones.
FtC3: Fox	Severe: cutbanks cave.	Moderate: shrink-swell, slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action, shrink-swell.	Moderate: slope, small stones.
FvB: Fox Variant	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Moderate: depth to rock, frost action, shrink-swell.	Moderate: depth to rock.
GrB2, GsB3: Glynwood	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: slope, shrink-swell, wetness.	Severe: frost action, low strength.	Slight.
HeG: Hennepin	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, low strength.	Severe: slope.
Ht: Houghton	Severe: ponding, excess humus.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength, frost action.	Severe: excess humus, ponding.
Lc: Landes	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: droughty, flooding.
Mg: Millgrove	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
MvC: Morley	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: 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
MvD: Morley	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
MwC2: Morley	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
MxC3: Morley	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Severe: too clayey.
OcA: Ockley	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, low strength.	Slight.
Pg: Patton	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
Pw: Pewamo	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
Py*. Pits						
Sn: Sloan	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness.
St: Sloan	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness.
Ud. Udorthents						
UfB*: Urban land.						
Fox	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, slope.	Moderate: frost action, shrink-swell.	Moderate: small stones.
UhB*: Urban land.						
Glynwood	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: slope, shrink-swell, wetness.	Severe: frost action, low strength.	Slight.
UmC*: Urban land.						

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
UmC*:						
Morley	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
Ut*:						
Urban land.						
Pewamo	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
Wa Wallkill	Severe: ponding, excess humus.	Severe: ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "poor," 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
BhA, BkB2-----------Blount	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Bn-----------------Bono	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
CuA----------------Crosby	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
FsA, FsB2-----------Fox	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
FtC3---------------Fox	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
FvB----------------Fox Variant	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
GrB2, GsB3----------Glynwood	Severe: percs slowly, wetness.	Moderate: slope.	Moderate: wetness, too clayey.	Moderate: wetness.	Fair: too clayey, wetness.
HeG----------------Hennepin	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Ht-----------------Houghton	Severe: ponding, percs slowly.	Severe: seepage, ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, seepage.	Poor: ponding, excess humus.
Lc-----------------Landes	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage.	Poor: seepage, too sandy.
Mg-----------------Millgrove	Severe: ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Poor: small stones, ponding.
MvC----------------Morley	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
MvD----------------Morley	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
MwC2, MxC3----------Morley	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, 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
OcA----------------- Ockley	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Slight-----------	Poor: small stones.
Pg------------------ Patton	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
Pw------------------ Pewamo	Severe: percs slowly, ponding.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, ponding, hard to pack.
Py*. Pits					
Sn------------------ Sloan	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
St------------------ Sloan	Severe: flooding, wetness, percs slowly.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Poor: wetness.
Ud. Udorthents					
UfB*: Urban land.					
Fox-----------------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
UhB*: Urban land.					
Glynwood------------	Severe: percs slowly, wetness.	Moderate: slope.	Moderate: wetness, too clayey.	Moderate: wetness.	Fair: too clayey, wetness.
UmC*: Urban land.					
Morley--------------	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Ut*: Urban land.					
Pewamo--------------	Severe: percs slowly, ponding.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, ponding, hard to pack.
Wa------------------ Wallkill	Severe: ponding, poor filter.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
BhA, BkB2: Blount	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Bn: Bono	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
CuA: Crosby	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
FsA, FsB2, FtC3: Fox	Good	Probable	Probable	Poor: small stones, area reclaim.
FvB: Fox Variant	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
GrB2, GsB3: Glynwood	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
HeG: Hennepin	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Ht: Houghton	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: wetness, excess humus.
Lc: Landes	Good	Probable	Improbable: too sandy.	Poor: thin layer.
Mg: Millgrove	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, wetness.
MvC: Morley	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
MvD: Morley	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
MwC2, MxC3: Morley	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
OcA: Ockley	Good	Probable	Probable	Poor: small stones, area reclaim.
Pg: Patton	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Pw: Pewamo	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Py*. Pits				
Sn------------------- Sloan	Poor: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
St------------------- Sloan	Poor: wetness.	Probable------------	Probable------------	Poor: area reclaim, wetness.
Ud. Udorthents				
UfB*: Urban land.				
Fox-----------------	Good----------------	Probable------------	Probable------------	Poor: small stones, area reclaim.
UhB*: Urban land.				
Glynwood------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
UmC*: Urban land.				
Morley--------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Ut*: Urban land.				
Pewamo--------------	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Wa------------------- Wallkill	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
BhA, BkB2 Blount	Slight	Moderate: piping, wetness.	Severe: no water.	Percs slowly, frost action.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily.
Bn Bono	Slight	Severe: ponding.	Severe: slow refill.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
CuA Crosby	Slight	Severe: piping.	Severe: no water.	Percs slowly, frost action.	Erodes easily, wetness.	Wetness, erodes easily, rooting depth.
FsA, FsB2 Fox	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Too sandy	Favorable.
FtC3 Fox	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, too sandy.	Slope.
FvB Fox Variant	Moderate: seepage, depth to rock.	Severe: thin layer.	Severe: no water.	Deep to water	Depth to rock, erodes easily.	Erodes easily, depth to rock, rooting depth.
GrB2, GsB3 Glynwood	Moderate: slope.	Moderate: wetness, piping.	Severe: no water.	Slope, percs slowly, frost action.	Erodes easily, wetness.	Erodes easily, rooting depth.
HeG Hennepin	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, percs slowly.	Slope, droughty, percs slowly.
Ht Houghton	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Frost action, subsides, ponding.	Ponding, soil blowing.	Wetness.
Lc Landes	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Deep to water	Too sandy, soil blowing.	Droughty.
Mg Millgrove	Severe: seepage.	Severe: piping, ponding.	Severe: cutbanks cave.	Ponding, frost action, cutbanks cave.	Ponding	Wetness.
MvC, MvD, MwC2 Morley	Severe: slope.	Slight	Severe: no water.	Deep to water	Slope, erodes easily, percs slowly.	Slope, erodes easily, rooting depth.
MxC3 Morley	Severe: slope.	Slight	Severe: no water.	Deep to water	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
OcA Ockley	Severe: seepage.	Moderate: thin layer, piping.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
Pg Patton	Slight	Severe: ponding.	Severe: slow refill.	Ponding, frost action.	Ponding	Wetness.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
Pw----------------- Pewamo	Slight----------	Severe: ponding.	Severe: slow refill.	Ponding, frost action.	Ponding---------	Wetness.
Py*. Pits						
Sn----------------- Sloan	Moderate: seepage.	Severe: piping, wetness.	Severe: slow refill.	Flooding, frost action.	Erodes easily, wetness.	Wetness, erodes easily.
St----------------- Sloan	Moderate: seepage.	Severe: thin layer, wetness.	Severe: slow refill, cutbanks cave.	Flooding, frost action.	Erodes easily, wetness.	Wetness, erodes easily.
Ud. Udorthents						
UfB*: Urban land.						
Fox---------------	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Too sandy------	Favorable.
UhB*: Urban land.						
Glynwood----------	Moderate: slope.	Moderate: wetness, piping.	Severe: no water.	Slope, percs slowly, frost action.	Erodes easily, wetness.	Erodes easily, rooting depth.
UmC*: Urban land.						
Morley------------	Severe: slope.	Slight----------	Severe: no water.	Deep to water	Slope, erodes easily, percs slowly.	Slope, erodes easily, rooting depth.
Ut*: Urban land.						
Pewamo------------	Slight----------	Severe: ponding.	Severe: slow refill.	Ponding, frost action.	Ponding---------	Wetness.
Wa----------------- Wallkill	Severe: seepage.	Severe: ponding, excess humus.	Moderate: slow refill.	Ponding, frost action.	Erodes easily, ponding.	Wetness, erodes easily.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
BhA-------------- Blount	0-9	Silt loam--------	CL	A-6, A-4	0-5	95-100	95-100	90-100	80-95	25-40	8-20
	9-34	Silty clay loam, clay, clay loam.	CH, CL	A-7, A-6	0-5	95-100	90-100	80-90	75-85	35-60	15-35
	34-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	90-100	90-100	80-100	70-90	30-45	10-25
BkB2------------- Blount	0-9	Silty clay loam	CL	A-6, A-7	0-5	95-100	95-100	90-100	80-95	30-45	15-25
	9-36	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
	36-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	90-100	90-100	80-100	70-90	30-45	10-25
Bn--------------- Bono	0-11	Silty clay-------	CH, CL	A-7	0	100	98-100	95-100	80-95	40-60	20-35
	11-37	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	100	98-100	95-100	90-100	40-66	26-44
	37-60	Clay, silty clay loam, silty clay.	CH, CL	A-7, A-6	0	100	98-100	95-100	90-100	35-60	20-40
CuA-------------- Crosby	0-8	Silt loam--------	CL, CL-ML, ML	A-4, A-6	0	100	95-100	80-100	50-90	15-30	4-15
	8-29	Clay loam, silty clay loam, clay.	CL	A-6, A-7	0-3	90-100	85-100	75-95	65-95	35-50	15-25
	29-60	Loam-------------	CL, ML, CL-ML	A-4, A-6	0-3	85-100	80-95	75-90	50-65	15-30	4-15
FsA, FsB2-------- Fox	0-9	Silt loam--------	ML, CL, SM, SC	A-4	0	70-100	65-100	60-95	45-90	<25	3-8
	9-15	Silty clay loam, silt loam, clay loam.	CL, SC, GC	A-2, A-6, A-7	0	65-100	55-100	40-100	30-95	22-50	10-25
	15-35	Clay loam, loam, gravelly sandy clay loam.	CL, SC, GC	A-2, A-6, A-7	0-5	65-100	55-100	30-100	15-80	22-45	10-25
	35-60	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
FtC3------------- Fox	0-7	Clay loam--------	CL, SC	A-2, A-4, A-6	0	70-100	65-100	60-100	25-95	25-40	9-20
	7-16	Silty clay loam, silt loam, clay loam.	CL, SC, GC	A-2, A-6, A-7	0	65-100	55-100	40-100	30-95	22-50	10-25
	16-25	Clay loam, loam, gravelly sandy clay loam.	CL, SC, GC	A-2, A-6, A-7	0-5	65-100	55-100	30-100	15-80	22-45	10-25
	25-60	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
FvB-------------- Fox Variant	0-13	Silt loam--------	CL, ML, CL-ML	A-4	0-5	95-100	90-100	75-100	55-90	<25	3-8
	13-21	Clay loam, sandy clay loam.	CL, SC	A-6, A-2-6	0-5	80-95	75-90	60-90	25-70	30-40	10-15
	21-25	Gravelly clay loam, gravelly sandy clay loam.	CL, SC, GC	A-6, A-2-6	5-10	55-80	50-75	40-75	20-60	30-40	10-15
	25	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
GrB2-------------- Glynwood	0-8	Silt loam--------	CL-ML, CL	A-4, A-6	0	95-100	90-100	80-100	55-90	23-40	4-15
	8-31	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
	31-60	Clay loam, silty clay loam.	CL	A-6, A-4	0-5	95-100	80-100	75-95	65-90	25-40	7-18
GsB3-------------- Glynwood	0-9	Silty clay-------	CH, CL	A-7	0-2	95-100	85-100	75-100	65-95	40-55	15-30
	9-27	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
	27-60	Clay loam, silty clay loam.	CL	A-6, A-4	0-5	95-100	80-100	75-95	65-90	25-40	7-18
HeG--------------- Hennepin	0-3	Clay loam--------	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	70-100	60-95	25-40	5-20
	3-13	Loam, clay loam, silt loam.	SC, SM-SC, CL, CL-ML	A-4, A-6, A-7	0-5	85-100	80-100	65-100	35-95	20-50	5-25
	13-60	Loam, sandy loam, clay loam.	SC, SM-SC, CL, CL-ML	A-4, A-6, A-7	0-5	85-100	80-100	65-100	35-95	20-50	5-25
Ht---------------- Houghton	0-60	Sapric material	PT	A-8	0	---	---	---	---	---	---
Lc---------------- Landes	0-14	Sandy loam-------	SM, SC, SM-SC	A-4, A-2	0	100	95-100	85-95	20-50	<25	NP-10
	14-60	Stratified sand to silt loam.	SM, ML, SP-SM, SC	A-2, A-4	0	100	95-100	60-95	10-70	<30	NP-10
Mg---------------- Millgrove	0-11	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	85-100	80-100	70-100	55-85	20-40	3-16
	11-29	Clay loam, sandy clay loam, loam.	CL, SC	A-6	0	85-100	80-100	70-95	40-75	25-40	11-26
	29-41	Gravelly loam, sandy loam, gravelly clay loam.	CL, CL-ML, SC, SM-SC	A-4, A-6, A-2, A-1	0-5	60-100	35-85	25-80	15-60	25-40	4-15
	41-60	Stratified very gravelly loam to fine sand.	SM, ML, GM, GM-GC	A-2, A-4	0-5	60-100	35-85	30-70	25-55	15-35	NP-10
MvC, MvD---------- Morley	0-9	Silt loam--------	CL, CL-ML	A-6, A-4	0-5	95-100	95-100	90-100	75-95	25-40	5-15
	9-16	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-50	15-30
	16-30	Silty clay, clay loam, clay.	CL, CH	A-7	0-10	95-100	90-100	85-95	80-90	40-60	15-35
	30-34	Silty clay loam, clay loam, silty clay.	CL, CH	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-60	15-30
	34-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-50	15-30
MwC2-------------- Morley	0-8	Clay loam--------	CL	A-6, A-7	0-5	95-100	90-100	85-95	80-90	30-45	15-25
	8-13	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-50	15-30
	13-24	Silty clay, clay loam, clay.	CL, CH	A-7	0-10	95-100	90-100	85-95	80-90	40-60	15-35
	24-30	Silty clay loam, clay loam, silty clay.	CL, CH	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-60	15-30
	30-60	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 > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
MxC3------------- Morley	0-8	Clay-------------	CH, CL	A-7	0-10	95-100	90-100	85-95	80-90	40-55	15-30
	8-11	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-50	15-30
	11-14	Silty clay, clay loam, clay.	CL, CH	A-7	0-10	95-100	90-100	85-95	80-90	40-60	15-35
	14-21	Silty clay loam, clay loam, clay.	CL, CH	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-60	15-30
	21-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-50	15-30
OcA-------------- Ockley	0-8	Silt loam--------	CL, ML, CL-ML	A-4	0	95-100	85-100	70-100	50-90	15-30	3-10
	8-23	Silty clay loam, clay loam, silt loam.	CL	A-6, A-4	0	90-100	80-100	70-90	55-90	25-40	8-15
	23-59	Sandy clay loam, sandy loam, gravelly sandy clay loam.	CL, SC	A-6, A-4, A-2	0-2	70-85	45-85	40-70	25-55	25-40	8-15
	59-60	Stratified sand to very gravelly coarse sand.	SP, SP-SM, GP, GP-GM	A-1	1-5	30-70	20-55	10-40	2-10	---	NP
Pg--------------- Patton	0-11	Silty clay loam	CL	A-6	0	100	100	95-100	75-95	30-40	15-25
	11-43	Silty clay loam	CL, CH, ML, MH	A-7	0	100	100	95-100	80-100	40-55	15-25
	43-60	Stratified silt loam to silty clay loam.	CL	A-6	0	100	100	95-100	75-95	25-40	10-20
Pw--------------- Pewamo	0-10	Silty clay loam	CL	A-6, A-7	0-5	90-100	80-100	80-100	70-90	35-50	15-25
	10-39	Clay loam, clay, silty clay loam.	CL, CH	A-7, A-6	0-5	95-100	90-100	90-100	75-95	35-55	15-30
	39-60	Clay loam, silty clay loam.	CL	A-7	0-5	95-100	90-100	90-100	70-90	40-50	15-25
Py*. Pits											
Sn--------------- Sloan	0-10	Clay loam--------	CL	A-6, A-7	0	100	95-100	85-100	70-95	35-45	12-20
	10-35	Silty clay loam, clay loam, silt loam.	CL, ML	A-6, A-7, A-4	0	100	90-100	85-100	75-95	30-45	8-18
	35-60	Stratified gravelly sandy loam to silty clay loam.	ML, CL	A-4, A-6	0	95-100	70-100	60-95	50-90	25-40	3-15
St--------------- Sloan	0-14	Silt loam--------	CL, CL-ML	A-4, A-6	0	90-100	85-95	75-95	55-85	20-35	5-15
	14-38	Loam, silt loam, clay loam.	CL	A-6, A-7	0	85-95	80-95	65-95	50-85	30-50	10-30
	38-48	Stratified sandy loam to silty clay loam.	CL-ML, CL, SC, SM-SC	A-4, A-6, A-7	0	85-95	80-95	45-95	35-85	25-45	5-20
	48-60	Coarse sand, gravelly sand.	SP, SP-SM	A-1, A-3, A-2	0-5	55-90	50-90	20-60	3-10	---	NP
Ud. Udorthents											

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
UfB*: Urban land.											
Fox	0-9	Silt loam	ML, CL, SM, SC	A-4	0	70-100	65-100	60-95	45-90	<25	3-8
	9-15	Silty clay loam, silt loam, clay loam.	CL, SC, GC	A-2, A-6, A-7	0	65-100	55-100	40-100	30-95	22-50	10-25
	15-35	Clay loam, loam, gravelly sandy clay loam.	CL, SC, GC	A-2, A-6, A-7	0-5	65-100	55-100	30-100	15-80	22-45	10-25
	35-60	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
UhB*: Urban land.											
Glynwood	0-8	Silt loam	CL-ML, CL	A-4, A-6	0	95-100	90-100	80-100	55-90	23-40	4-15
	8-31	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
	31-60	Clay loam, silty clay loam.	CL	A-6, A-4	0-5	95-100	80-100	75-95	65-90	25-40	7-18
UmC*: Urban land.											
Morley	0-8	Clay loam	CL	A-6, A-7	0-5	95-100	90-100	85-95	80-90	30-50	15-30
	8-13	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-50	15-30
	13-24	Silty clay, clay loam, clay.	CL, CH	A-7	0-10	95-100	90-100	85-95	80-90	40-60	15-35
	24-30	Silty clay loam, clay loam, silty clay.	CL, CH	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-60	15-30
	30-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-10	95-100	90-100	85-95	80-90	30-50	15-30
Ut*: Urban land.											
Pewamo	0-10	Silty clay loam	CL	A-6, A-7	0-5	90-100	80-100	80-100	70-90	35-50	15-25
	10-39	Clay loam, clay, silty clay loam.	CL, CH	A-7, A-6	0-5	95-100	90-100	90-100	75-95	35-55	15-30
	39-60	Clay loam, silty clay loam.	CL	A-7	0-5	95-100	90-100	90-100	70-90	40-50	15-25
Wa: Wallkill	0-9	Silt loam	ML, CL-ML, CL	A-4, A-6	0	95-100	90-100	75-100	60-85	16-32	3-12
	9-30	Silt loam, loam	CL-ML, CL	A-4, A-6	0	90-100	85-100	75-100	60-85	20-34	6-13
	30-60	Sapric material, hemic material.	PT, OH	A-8	0	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
BhA-------------- 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
	9-34	35-50	1.40-1.70	0.06-0.6	0.12-0.19	4.5-7.8	Moderate-----	0.43			
	34-60	27-38	1.60-1.85	0.06-0.2	0.07-0.10	7.4-8.4	Moderate-----	0.43			
BkB2------------- Blount	0-9	27-30	1.40-1.60	0.2-0.6	0.18-0.22	5.1-7.3	Moderate-----	0.43	3	6	2-3
	9-36	35-50	1.40-1.70	0.06-0.2	0.12-0.19	4.5-7.8	Moderate-----	0.43			
	36-60	27-38	1.60-1.85	0.06-0.2	0.07-0.10	7.4-8.4	Moderate-----	0.43			
Bn--------------- Bono	0-11	35-45	1.20-1.45	0.2-2.0	0.20-0.23	6.1-7.3	High----------	0.28	5	4	4-8
	11-37	40-55	1.35-1.55	0.06-0.2	0.10-0.14	6.1-8.4	High----------	0.28			
	37-60	35-60	1.45-1.60	0.06-0.2	0.08-0.12	6.6-8.4	High----------	0.28			
CuA-------------- Crosby	0-8	11-24	1.35-1.45	0.6-2.0	0.20-0.24	5.1-7.3	Low-----------	0.43	3	5	1-3
	8-29	35-45	1.50-1.70	0.06-0.2	0.15-0.20	5.1-7.3	Moderate-----	0.43			
	29-60	15-27	1.70-2.00	0.06-0.6	0.05-0.17	7.4-8.4	Low-----------	0.43			
FsA, FsB2-------- Fox	0-9	10-17	1.35-1.55	0.6-2.0	0.17-0.24	5.1-7.3	Low-----------	0.37	4	5	1-3
	9-15	18-35	1.55-1.65	0.6-2.0	0.10-0.22	5.1-7.3	Moderate-----	0.43			
	15-35	18-35	1.55-1.65	0.6-2.0	0.10-0.19	5.1-8.4	Moderate-----	0.32			
	35-60	0-2	1.30-1.80	>6.0	0.02-0.07	7.4-8.4	Low-----------	0.10			
FtC3------------- Fox	0-7	20-35	1.55-1.65	0.6-2.0	0.14-0.23	5.1-7.3	Moderate-----	0.32	3	6	.5-2
	7-16	18-35	1.55-1.65	0.6-2.0	0.10-0.22	5.1-7.3	Moderate-----	0.43			
	16-25	18-35	1.55-1.65	0.6-2.0	0.10-0.19	5.1-8.4	Moderate-----	0.32			
	25-60	0-2	1.30-1.80	>6.0	0.02-0.07	7.4-8.4	Low-----------	0.10			
FvB-------------- Fox Variant	0-13	10-20	1.25-1.45	0.6-2.0	0.20-0.24	5.1-7.3	Low-----------	0.37	4	5	1-3
	13-21	25-35	1.50-1.70	0.6-2.0	0.15-0.19	5.6-7.3	Moderate-----	0.37			
	21-25	25-35	1.55-1.75	0.6-2.0	0.15-0.17	5.6-7.3	Moderate-----	0.24			
	25	---	---	---	---	---	-------------	----			
GrB2------------- Glynwood	0-8	16-27	1.25-1.50	0.6-2.0	0.20-0.24	5.6-7.3	Low-----------	0.43	3	6	1-3
	8-31	35-55	1.45-1.75	0.06-0.2	0.11-0.18	4.5-7.8	Moderate-----	0.32			
	31-60	27-36	1.65-1.85	0.06-0.2	0.06-0.10	7.4-8.4	Moderate-----	0.32			
GsB3------------- Glynwood	0-9	40-50	1.35-1.50	0.06-0.2	0.14-0.16	5.6-7.3	Moderate-----	0.32	2	4	.5-2
	9-27	35-55	1.45-1.75	0.06-0.2	0.11-0.18	5.1-7.8	Moderate-----	0.32			
	27-60	27-36	1.65-1.85	0.06-0.2	0.06-0.10	7.4-8.4	Moderate-----	0.32			
HeG-------------- Hennepin	0-3	20-30	1.20-1.40	0.6-2.0	0.18-0.24	6.6-8.4	Low-----------	0.32	4	5	1-2
	3-13	18-30	1.30-1.60	0.2-0.6	0.14-0.22	6.6-8.4	Low-----------	0.32			
	13-60	18-30	1.45-1.70	0.06-0.6	0.07-0.11	7.4-8.4	Low-----------	0.32			
Ht--------------- Houghton	0-60	---	0.15-0.45	0.2-6.0	0.35-0.45	5.6-7.8	-------------	----	2	2	>70
Lc--------------- Landes	0-14	5-20	1.40-1.60	2.0-6.0	0.10-0.18	6.1-8.4	Low-----------	0.20	5	3	1-2
	14-60	8-18	1.60-1.80	6.0-20	0.05-0.15	6.1-8.4	Low-----------	0.20			
Mg--------------- Millgrove	0-11	18-27	1.30-1.50	0.6-2.0	0.19-0.24	5.6-7.3	Low-----------	0.28	5	6	3-8
	11-29	18-35	1.40-1.70	0.6-2.0	0.12-0.16	6.1-7.8	Moderate-----	0.28			
	29-41	15-30	1.25-1.60	0.6-2.0	0.08-0.15	6.1-7.8	Low-----------	0.20			
	41-60	5-18	1.25-1.60	2.0-6.0	0.08-0.12	6.6-8.4	Low-----------	0.28			

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
MvC, MvD---------- Morley	0-9	22-27	1.35-1.55	0.6-2.0	0.20-0.24	5.1-6.5	Low----------	0.43	3	6	1-3
	9-16	27-40	1.45-1.65	0.2-0.6	0.18-0.20	5.1-6.5	Moderate-----	0.43			
	16-30	35-50	1.55-1.70	0.2-0.6	0.11-0.15	6.1-7.8	Moderate-----	0.43			
	30-34	27-50	1.60-1.80	0.06-0.2	0.07-0.12	6.1-8.4	Moderate-----	0.43			
	34-60	27-40	1.60-1.80	0.06-0.2	0.07-0.12	6.1-8.4	Moderate-----	0.43			
MwC2-------------- Morley	0-8	27-35	1.40-1.60	0.2-0.6	0.18-0.22	5.1-6.5	Moderate-----	0.43	3	7	1-3
	8-13	27-40	1.45-1.65	0.2-0.6	0.18-0.20	5.1-6.5	Moderate-----	0.43			
	13-24	35-50	1.55-1.70	0.2-0.6	0.11-0.15	6.1-7.8	Moderate-----	0.43			
	24-30	27-50	1.60-1.80	0.06-0.2	0.07-0.12	6.1-8.4	Moderate-----	0.43			
	30-60	27-40	1.60-1.80	0.06-0.2	0.07-0.12	6.1-8.4	Moderate-----	0.43			
MxC3-------------- Morley	0-8	40-50	1.35-1.55	0.06-0.2	0.14-0.16	5.6-7.3	High---------	0.32	2	4	.5-2
	8-11	27-40	1.45-1.65	0.2-0.2	0.18-0.20	5.1-6.5	Moderate-----	0.43			
	11-14	35-50	1.55-1.70	0.2-0.2	0.11-0.15	6.1-7.8	Moderate-----	0.43			
	14-21	27-50	1.60-1.70	0.06-0.2	0.07-0.12	6.1-8.4	Moderate-----	0.43			
	21-60	27-40	1.60-1.70	0.06-0.2	0.07-0.12	6.1-8.4	Moderate-----	0.43			
OcA--------------- Ockley	0-8	11-22	1.30-1.45	0.6-2.0	0.20-0.24	5.1-6.5	Low----------	0.37	5	5	.5-3
	8-23	20-35	1.45-1.60	0.6-2.0	0.15-0.22	4.5-6.0	Moderate-----	0.37			
	23-59	15-35	1.40-1.55	0.6-2.0	0.06-0.11	5.1-7.3	Moderate-----	0.24			
	59-60	2-5	1.60-1.80	>20	0.02-0.04	7.4-8.4	Low----------	0.10			
Pg---------------- Patton	0-11	27-35	1.15-1.35	0.6-2.0	0.21-0.23	6.1-7.3	Moderate-----	0.28	5	7	3-5
	11-43	27-35	1.25-1.45	0.6-2.0	0.18-0.20	6.6-7.8	Moderate-----	0.28			
	43-60	22-35	1.30-1.50	0.2-0.6	0.18-0.22	6.6-7.8	Moderate-----	0.28			
Pw---------------- Pewamo	0-10	27-40	1.35-1.55	0.6-2.0	0.17-0.22	6.1-7.3	Moderate-----	0.28	5	6	3-10
	10-39	35-50	1.40-1.70	0.2-0.6	0.12-0.20	5.6-7.8	Moderate-----	0.28			
	39-60	30-40	1.50-1.75	0.2-0.6	0.14-0.18	6.6-8.4	Moderate-----	0.28			
Py*. Pits											
Sn---------------- Sloan	0-10	27-33	1.25-1.50	0.6-2.0	0.18-0.22	6.1-7.8	Moderate-----	0.37	5	6	3-6
	10-35	22-35	1.25-1.55	0.2-2.0	0.15-0.19	6.1-7.8	Moderate-----	0.37			
	35-60	10-30	1.20-1.50	0.2-2.0	0.13-0.18	6.6-8.4	Low----------	0.37			
St---------------- Sloan	0-14	15-27	1.20-1.40	0.6-2.0	0.20-0.24	6.1-7.8	Low----------	0.37	5	6	3-6
	14-38	20-35	1.25-1.55	0.2-2.0	0.17-0.20	6.1-7.8	Moderate-----	0.37			
	38-48	10-30	1.25-1.55	0.2-2.0	0.19-0.21	6.6-8.4	Low----------	0.37			
	48-60	0-10	1.20-1.50	6.0-20	0.02-0.05	6.6-8.4	Low----------	0.10			
Ud. Udorthents											
UfB*: Urban land.											
Fox----------------	0-9	10-17	1.35-1.55	0.6-2.0	0.17-0.24	5.1-7.3	Low----------	0.37	4	5	1-3
	9-15	18-35	1.55-1.65	0.6-2.0	0.10-0.22	5.1-7.3	Moderate-----	0.43			
	15-35	18-35	1.55-1.65	0.6-2.0	0.10-0.19	5.1-8.4	Moderate-----	0.32			
	35-60	0-2	1.30-1.80	>6.0	0.02-0.7	7.4-8.4	Low----------	0.10			
UhB*: Urban land.											
Glynwood---------	0-8	16-27	1.25-1.50	0.6-2.0	0.20-0.24	5.6-7.3	Low----------	0.43	3	6	1-3
	8-31	35-55	1.45-1.75	0.06-0.2	0.11-0.18	4.5-7.8	Moderate-----	0.32			
	31-60	27-36	1.65-1.85	0.06-0.2	0.06-0.10	7.4-8.4	Moderate-----	0.32			

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
UmC*: Urban land.											
Morley----------	0-8	27-35	1.40-1.60	0.2-0.6	0.18-0.22	5.1-6.5	Moderate-----	0.43	3	7	.5-2
	8-13	27-40	1.45-1.65	0.2-0.6	0.18-0.20	5.1-6.5	Moderate-----	0.43			
	13-24	35-50	1.55-1.70	0.2-0.6	0.11-0.15	6.1-7.8	Moderate-----	0.43			
	24-30	27-50	1.60-1.80	0.06-0.6	0.07-0.12	6.1-8.4	Moderate-----	0.43			
	30-60	27-40	1.60-1.80	0.06-0.6	0.07-0.12	6.1-8.4	Moderate-----	0.43			
Ut*: Urban land.											
Pewamo----------	0-10	27-40	1.35-1.55	0.6-2.0	0.17-0.22	6.1-7.3	Moderate-----	0.28	5	6	3-10
	10-39	35-50	1.40-1.70	0.2-0.6	0.12-0.20	5.6-7.8	Moderate-----	0.28			
	39-60	30-40	1.50-1.75	0.2-0.6	0.14-0.18	7.4-8.4	Moderate-----	0.28			
Wa--------------- Wallkill	0-9	10-27	1.15-1.40	0.6-2.0	0.16-0.21	5.1-7.8	Low----------	0.37	5	---	3-8
	9-30	15-27	1.15-1.40	0.6-2.0	0.15-0.20	5.1-7.8	Low----------	0.32			
	30-60	---	0.25-0.45	2.0-20	0.35-0.45	5.6-7.8	-------------	----			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "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	Hydro- logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
BhA, BkB2--------- Blount	C	None---------	---	---	1.0-3.0	Perched	Jan-May	>60	---	High-----	High-----	High.
Bn----------------- Bono	D	None---------	---	---	+1-1.0	Apparent	Dec-May	>60	---	Moderate	High-----	Low.
CuA---------------- Crosby	C	None---------	---	---	1.0-3.0	Perched	Jan-Apr	>60	---	High-----	High-----	Moderate.
FsA, FsB2, FtC3--- Fox	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
FvB---------------- Fox Variant	B	None---------	---	---	>6.0	---	---	20-40	Hard	Moderate	Low------	Moderate.
GrB2, GsB3--------- Glynwood	C	None---------	---	---	2.0-3.5	Perched	Jan-Apr	>60	---	High-----	High-----	Moderate.
HeG---------------- Hennepin	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Low.
Ht----------------- Houghton	A/D	None---------	---	---	+1-1.0	Apparent	Sep-Jun	>60	---	High-----	High-----	Low.
Lc----------------- Landes	B	Occasional	Brief-----	Jan-Jun	4.0-6.0	Apparent	Mar-May	>60	---	Moderate	Low------	Low.
Mg----------------- Millgrove	B/D	None---------	---	---	+1-1.0	Apparent	Nov-May	>60	---	High-----	High-----	Low.
MvC, MvD, MwC2, MxC3-------------- Morley	C	None---------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Moderate.
OcA---------------- Ockley	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Pg---------------- Patton	B/D	None---------	---	---	+.5-2.0	Apparent	Mar-Jun	>60	---	High------	High------	Low.
Pw---------------- Pewamo	C/D	None---------	---	---	+1-1.0	Apparent	Dec-May	>60	---	High------	High------	Low.
Py*. Pits												
Sn, St------------ Sloan	B/D	Occasional	Brief------	Nov-Jun	0-1.0	Apparent	Nov-Jun	>60	---	High------	High------	Low.
Ud. Udorthents												
UfB*: Urban land.												
Fox----------------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
UhB*: Urban land.												
Glynwood----------	C	None---------	---	---	2.0-3.5	Perched	Jan-Apr	>60	---	High------	High------	Moderate.
UmC*: Urban land.												
Morley------------	C	None---------	---	---	>6.0	---	---	>60	---	Moderate	High------	Moderate.
Ut*: Urban land.												
Pewamo------------	C/D	None---------	---	---	+1-1.0	Apparent	Dec-May	>60	---	High------	High------	Low.
Wa---------------- Wallkill	B/D	None---------	---	---	+.5-1.0	Apparent	Sep-Jun	>60	---	High------	Moderate	Moderate.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 19.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

Soil name	Family or higher taxonomic class
Blount	Fine, illitic, mesic Aeric Ochraqualfs
Bono	Fine, illitic, mesic Typic Haplaquolls
Crosby	Fine, mixed, mesic Aeric Ochraqualfs
Fox	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludalfs
Fox Variant	Fine-loamy, mixed, mesic Typic Hapludalfs
Glynwood	Fine, illitic, mesic Aquic Hapludalfs
Hennepin	Fine-loamy, mixed, mesic Typic Eutrochrepts
Houghton	Euic, mesic Typic Medisaprists
Landes	Coarse-loamy, mixed, mesic Fluventic Hapludolls
Millgrove	Fine-loamy, mixed, mesic Typic Argiaquolls
Morley	Fine, illitic, mesic Typic Hapludalfs
Ockley	Fine-loamy, mixed, mesic Typic Hapludalfs
Patton	Fine-silty, mixed, mesic Typic Haplaquolls
Pewamo	Fine, mixed, mesic Typic Argiaquolls
Sloan	Fine-loamy, mixed, mesic Fluvaquentic Haplaquolls
Udorthents	Loamy, mixed, nonacid, mesic Udorthents
*Wallkill	Fine-loamy, mixed, nonacid, mesic Thapto-Histic Fluvaquents

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