# SOIL SURVEY OF

# LOGAN COUNTY, OHIO

United States Department of Agriculture, Soil Conservation Service
In cooperation with
Ohio Department of Natural Resources, Division of Lands and Soil, and
Ohio Agricultural Research and Development Center

# HOW TO U

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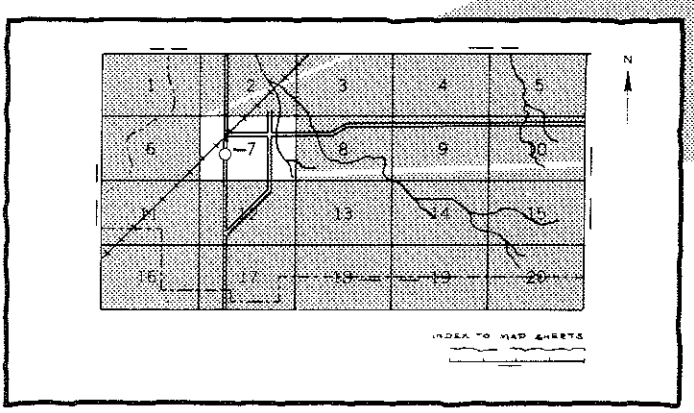


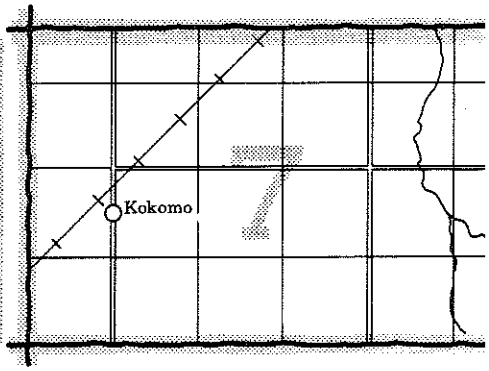


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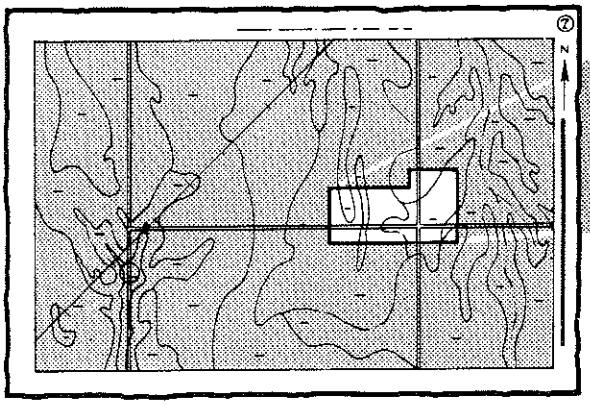
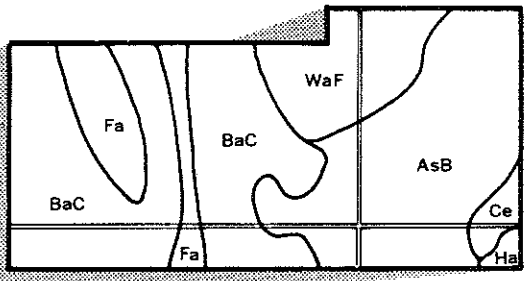
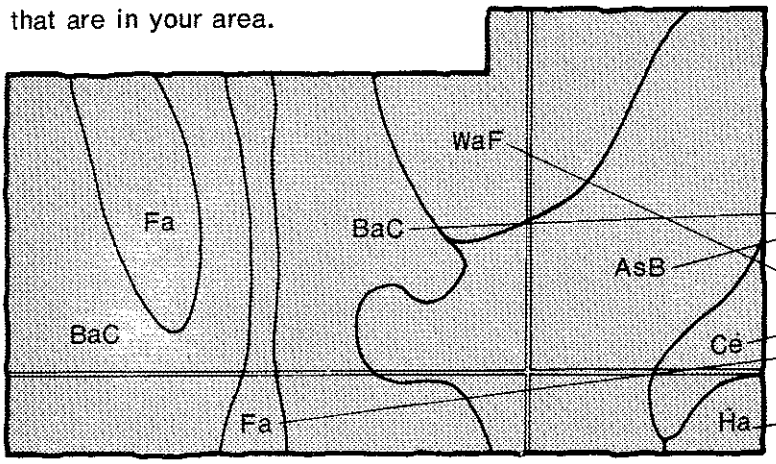



**4.** List the map unit symbols that are in your area.




**Symbols**

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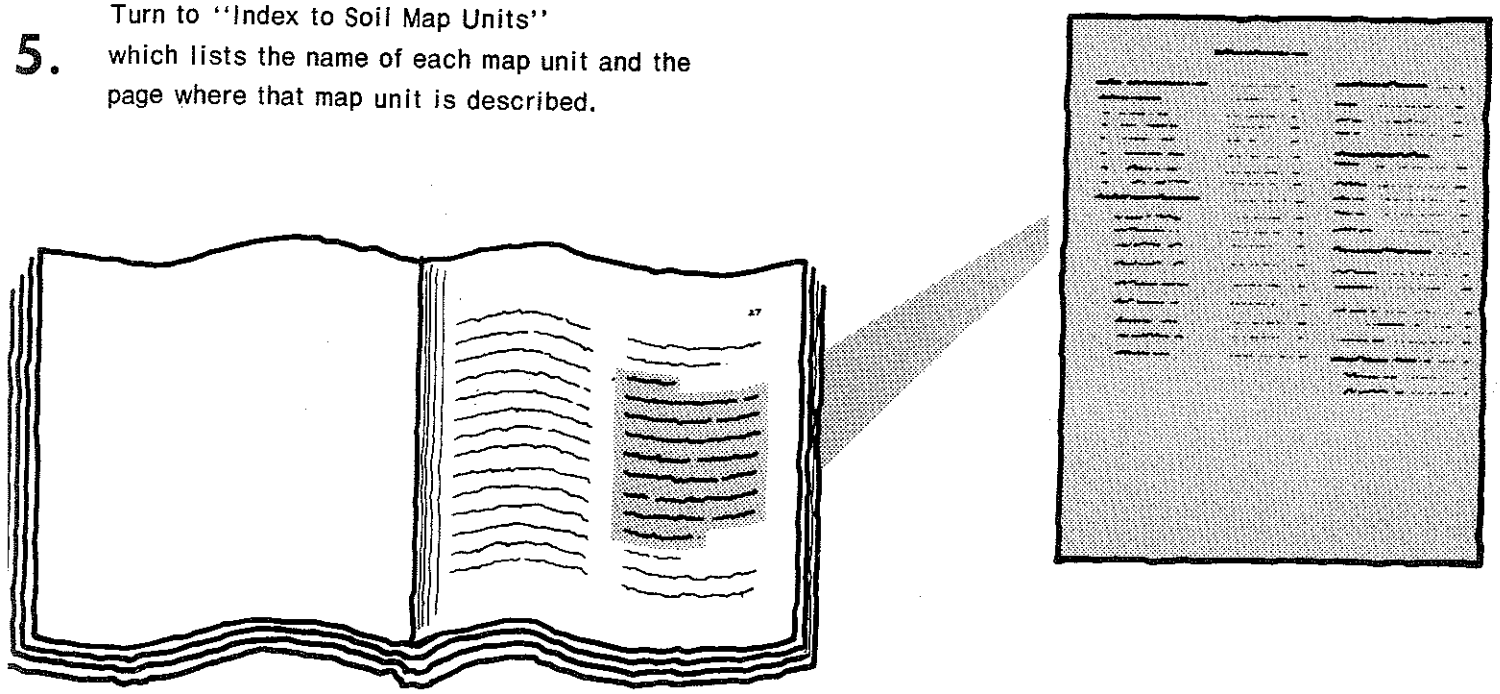
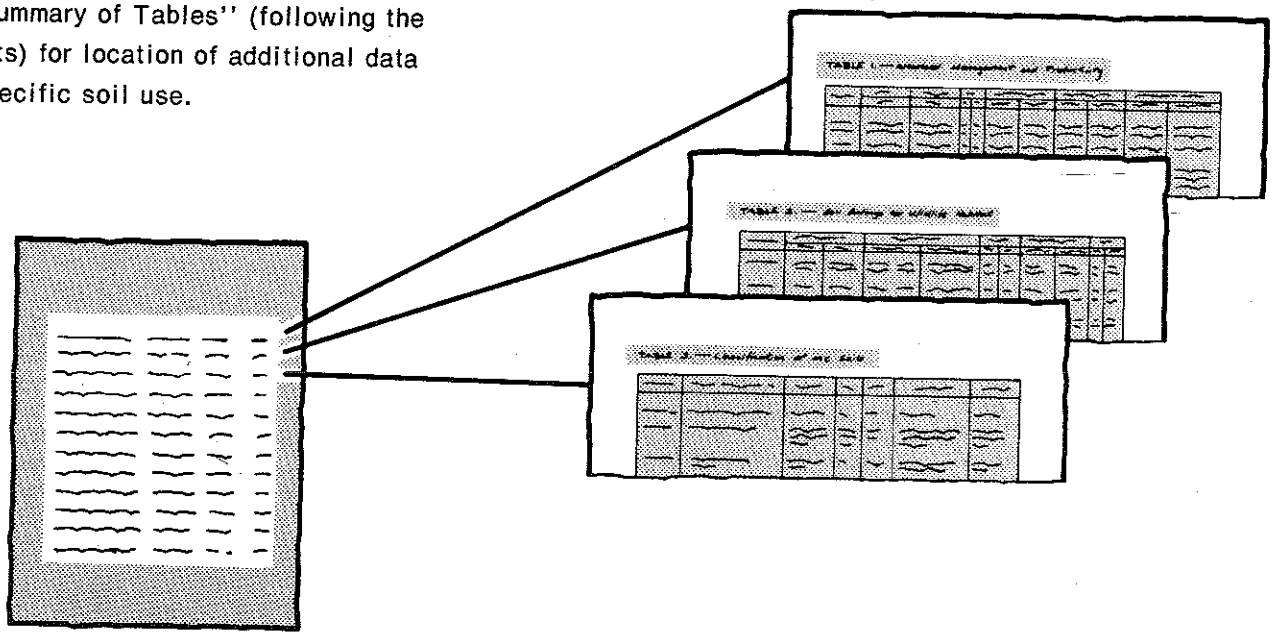
# HIS SOIL SURVEY

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.



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

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

Major fieldwork for this soil survey was completed in the period 1968-1975. Soil names and descriptions were approved in 1977. Unless otherwise indicated, statements in the publication refer to conditions in the survey area in 1977. This survey was made cooperatively by the Soil Conservation Service; the Ohio Department of Natural Resources, Division of Lands and Soil; and the Ohio Agricultural Research and Development Center. It is part of the technical assistance furnished to the Logan Soil and Water Conservation District. The Logan County Commissioners provided some of the funds for this survey.

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

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# Foreword

We introduce the Soil Survey of Logan County, Ohio. You will find, herein, basic information useful in any land-planning program. Of prime importance are the predictions of soil behavior for selected land uses. Also highlighted are limitations or hazards to land uses that are inherent in the soil, improvements needed to overcome these limitations, and the impact that selected land uses will have on the environment.

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

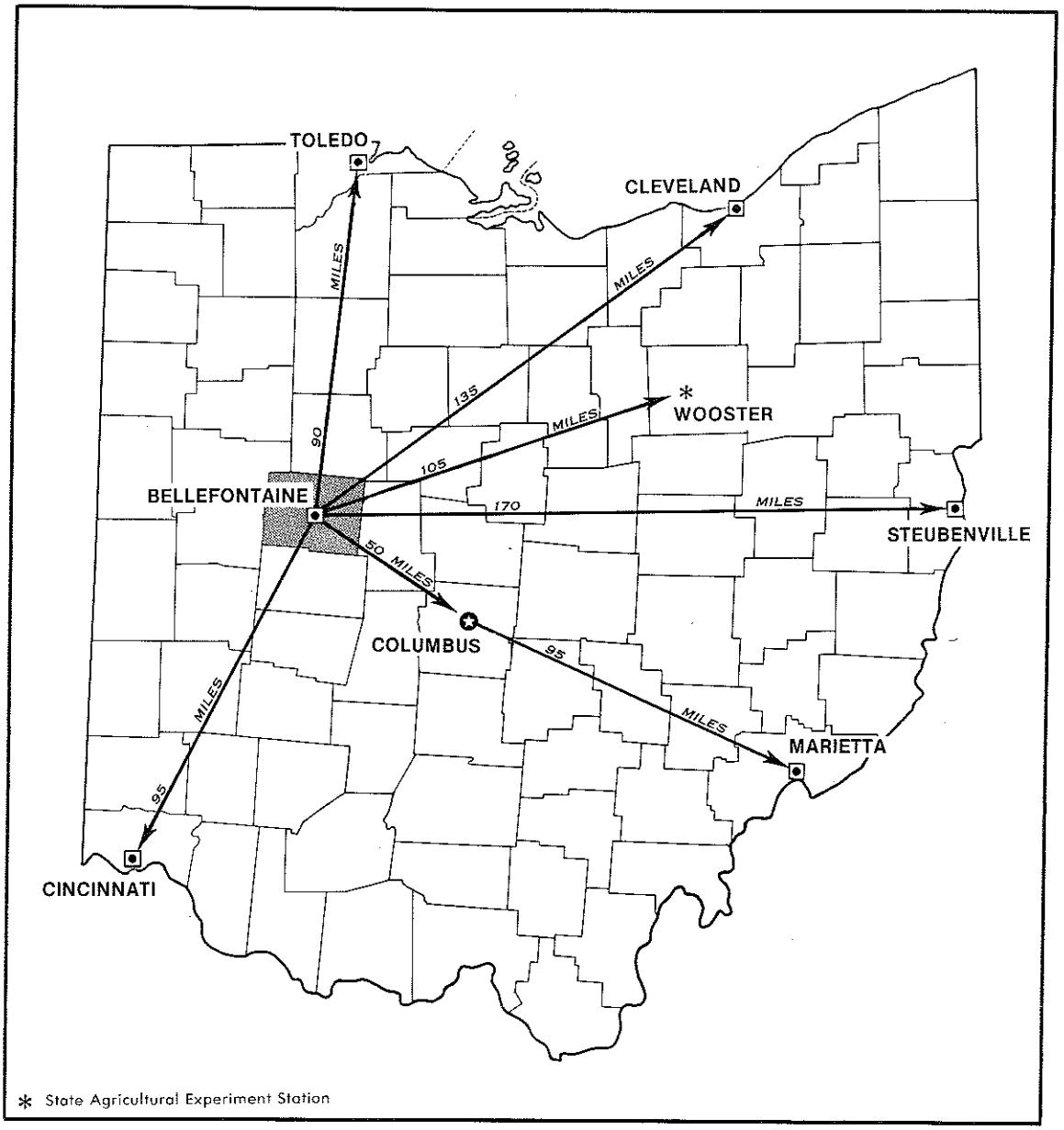
Many people assume that soils are all somewhat alike. They are unaware that great differences in soil properties can occur even within short distances. Soils may be seasonally wet or subject to flooding. They may be shallow to bedrock. They may be too unstable to be used as a foundation for buildings or roads. Very clayey or wet soils are poorly suited to septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. This publication also shows, on the general soil map, the location of broad areas of soil and, on detailed soil maps, the location of each kind of soil. It provides descriptions of each kind of soil in the survey area and gives much information about each soil for specific uses. Additional information or assistance in using this publication can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

We believe that this soil survey can be useful in the conservation, development, and productive use of soil, water, and other resources.

Robert E. Quilliam

Robert E. Quilliam
State Conservationist
Soil Conservation Service




*Location of Logan County in Ohio.*

# SOIL SURVEY OF LOGAN COUNTY, OHIO

**By D. D. Waters, Ohio Department of Natural Resources, Division of Lands and Soil, and V. L. Siegenthaler, Soil Conservation Service**

**Fieldwork by D. D. Waters, T. E. Lucht, and T. E. Graham, Ohio Department of Natural Resources, Division of Lands and Soil, and V. L. Siegenthaler, Soil Conservation Service**

**United States Department of Agriculture, Soil Conservation Service in cooperation with the Ohio Department of Natural Resources, Division of Lands and Soil, and the Ohio Agricultural Research and Development Center**

## General nature of the county

LOGAN COUNTY is in the west-central part of Ohio (see map on facing page). It occupies about 460 square miles, or 294,464 acres. In 1970, it had a total population of 35,072. Bellefontaine, the county seat and only city, is near the center of the county. The highest point in Ohio is a summit just northeast of Bellefontaine.

Farming, dominantly cash grain, livestock, and dairy farming, is the major enterprise in the county (fig. 1). Corn, soybeans, wheat, oats, and hay are grown on many farms, particularly in the flatter western and northern parts of the county. Much of the woodland is dissected areas of sloping to very steep soils along streams and on end moraines in the southeastern and south-central parts.

Poor natural drainage is the major soil limitation for farming and community development in the flatter areas. Erosion is the major hazard in sloping to very steep areas. If adequate artificial drainage and erosion control are provided and farmed areas are otherwise well managed, most of the soils in Logan County can be highly productive.

Although Logan County is dominantly agricultural, nonfarm development, particularly residential and recreational development, is constantly taking place. This development is not on the scale that prevails in or near large metropolitan areas. Many of the same limitations and hazards, however, are encountered, particularly near Indian Lake.

### Climate

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

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

In winter the average temperature is 29 degrees F, and the average daily minimum temperature is 21 degrees. The lowest temperature on record, which occurred at Bellefontaine on January 16, 1972, is -22 degrees. In summer the average temperature is 71 degrees, and the average daily maximum temperature is 82 degrees. The highest recorded temperature, which occurred on July 7, 1952, is 99 degrees.

Growing degree days, shown in table 1, are equivalent to heat units. During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

Of the total annual precipitation, 21 inches, or 60 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 16 inches. The heaviest 1-day rainfall during the period of record was 3.66 inches, at Bellefontaine on June 26, 1971. Thunderstorms occur on about 40 days each year, and most occur in summer.

Average seasonal snowfall is 22 inches. The greatest snow depth at any one time during the period of record was 11 inches. On the average, 13 days have at least 1 inch of snow on the ground, but the number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The percentage of possible

sunshine is 65 in summer and 40 in winter. The prevailing wind is from the south-southwest. Average windspeed is highest, 10 miles per hour, in winter.

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

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

## Physiography, relief, and drainage

Logan County is a part of the Indiana and Ohio Till Plain section of the Central Lowlands physiographic province. The relief varies because of the movements of the Wisconsin glacier. Parts of eight glacial end moraines and associated ground moraines occur in the county in a complex pattern. Areas along the western edge of the county and in the northwest, northeast, and southwest corners dominantly are parts of a nearly level and gently sloping ground moraine where most major differences in topography are along streams and on the Beehive moraine, which bisects the northwest corner. Blount, Pewamo, and Wetzel soils are dominant on the ground moraine in the western and northeastern areas, and Brookston and Crosby soils are dominant in the southwestern area.

Inward from these four areas, the landscape is nearly level to very steep because it is dissected by the Farmersville, Cable, Powell, and Broadway moraines. The moraines tend to arc around a "bedrock high" near Bellefontaine. Eldean and Miamian soils are dominant on the Farmersville moraine and Celina, Crosby, and Miamian soils on the Cable moraine.

The glacial till on the Powell moraine is somewhat finer textured than that on the Farmersville and Cable moraines. Blount and Glynwood soils are dominant on the Powell moraine. The nearly level to sloping Nappanee, Paulding, and St. Clair soils are between the Powell and Broadway moraines.

Logan County is drained by two river systems, the Great Miami River Basin in the western two-thirds of the county and the Scioto River Basin in the eastern third. The Great Miami River Basin has two subbasins in the county—the Upper Miami River and the Upper Mad River. The Great Miami River Basin drains the southwestern part of the county, including a narrow projection, the McKees Creek Valley, which extends to the central part of the county. The flood plains, terraces, and lakebed areas on this drainage basin are dominated by Del Rey, Eldean, Lippincott, and Montgomery soils.

The Upper Miami River Basin drains much of the western and northern parts of the county and extends to the central part. Within this basin lies Indian Lake, an artificial body of water covering 5,800 acres. This lake formed in a naturally swampy lakebed area. The flood plains, terraces, and lakebed areas in this basin are dominanted by Eel, Eldean, Fulton, and Montgomery soils.

The Upper Mad River Basin drains an area extending from the east-central part of the county to the south-central edge. This area is the beginning of a large glacial outwash plain that extends southward into Champaign County. This outwash plain has many high and low terraces occurring in association with flood plains. Here, Algiers, Eldean, Fox, Genesee, Homer, Lippincott, and Wallkill soils dominate.

Four main tributaries of the Scioto River are in the Scioto River Basin in the eastern third of the county. These tributaries are Big Darby, Bokes, Mill, and Rush Creeks. Also in this basin is a sizeable lakebed area northeast of the village of East Liberty. Eel, Latty, Montgomery, and Shoals soils are dominant on the flood plains, terraces, and lakebed areas in this drainage basin.

## Geology

Logan County has been covered by continental glaciers at least twice. Wisconsin-age glacial deposits cover the entire county, and older glacial deposits are in deeply buried valleys. These deposits include glacial till; glacial outwash; loess, or silty wind-blown deposits; lacustrine material, or clayey and silty water-deposited material; and alluvium that was washed from these materials. The soils formed in the underlying bedrock only in a few areas on stream valley walls and in areas of thin deposits of glacial till. Berks and Weikert soils formed in the shale bedrock of Devonian age on steep valley walls. Milton soils formed in areas where the glacial till is shallow over limestone bedrock.

The glacial history of the county is very complex. The Wisconsin glacier entered the county from the north and encountered resistance from a "bedrock high" called the "Bellefontaine Outlier." Masses moved on each side of the bedrock high. One mass, called the Miami Lobe, moved in a southwesterly direction and the other mass, called the Scioto Lobe, in a southeasterly direction.

The movement of the glacial ice over limestone and dolomite bedrock enriched the glacial till with a high percentage of limestone and dolomite pebbles and fine material in the form of ground-up limestone and dolomite. The glacial drift in Logan County also contains numerous igneous rocks that were transported for hundreds of miles from the north. An outstanding example of this phenomenon is known as the "Glacial Boulder Belt," part of which is in an area in the southwest corner of the county where igneous rocks are on and beneath the soil surface.

During a warm, dry period immediately after the glacial period, winds blew fine silt-size particles from the bare glacial drift out of the region to the west and deposited the material to varying depths in the other areas of glacial drift within the county. The deposit of this silty

material, or loess, is as much as 18 inches thick. Blount, Celina, Crosby, Glynwood, Miamian, and Morley soils formed in these areas.

During the last retreat of the glacier, the melt water cut channels through the glacial drift, creating most of the drainage pattern that exists today. In places the melt water deposits are large areas of outwash sand and gravel. Fox, Eldean, Casco, and Rodman soils formed in areas where little or no loess was deposited on the outwash. Ockley, Sleeth, and Westland soils formed in areas where the outwash sand and gravel was covered by several inches of loess or silty alluvial sediments.

In the present stream valleys, a more recent deposition of soil material has taken place. This material is alluvium eroded from soils on uplands and terraces and deposited on the floor of flood plains. Algiers, Genesee, Eel, Shoals, and Sloan soils formed in this material.

## Farming

In 1974, about 82 percent of the land area in Logan County was farmed. In 1976, the major commodities, ranked according to the percentage of total cash receipts in the county, were corn, 26 percent; dairy products, 24 percent; soybeans, 18 percent; cattle, 10 percent; poultry, 6 percent; hogs, 6 percent; wheat, 5 percent; hay, 1 percent; and all other, 4 percent (*4*).

According to the Census of Agriculture, the average size of farms increased from 157 acres in 1964 to 184 acres in 1974. The number of farms decreased during this period from 1,552 to 1,312.

The acreage in corn grown for all purposes increased from 45,315 acres in 1964 to 60,201 acres in 1974 and that in wheat from 17,011 to 20,570 acres. The acreage in soybeans grown for grain noticeably increased from 28,716 to 58,263 acres during this period. Conversely, the acreage in hay decreased from 32,972 to 18,831 acres. The number of hogs and pigs decreased from 27,720 in 1964 to 24,230 in 1974 and the number of cattle and calves from 32,852 to 29,895.

## Urban trends

One of the main environmental factors affecting the use of soils in Logan County is urban pressure, or the demand for land for use as homesites and, to some extent, as commercial and industrial sites. As a result of the recent establishment of a Federal and State Transportation Research Facility, about 4,600 acres in the eastern part of the county is no longer farmed. The establishment of this facility increased the pressure on farmland by creating a need for new homesites. This urban pressure is evident in an ever widening area extending from West Liberty in the south-central part of the county northward through Bellefontaine and to Indian Lake, a resort area in the northwestern part.

Most of the new homes have been built on lots of less than an acre. The number of larger tracts that are developed as homesites, however, is rapidly increasing. These tracts are mostly 5 acres or slightly larger. The homes are served by existing roads and streets.

Farming is still the dominant use in sizeable parts of the county. The soils in these large areas are mainly somewhat poorly drained to very poorly drained and generally are not so suitable as building sites. New houses are built along the roads and near the villages, but the urban development is not extensive.

## Water supply

The ground water supply is adequate for the needs of the present and the immediate future in most parts of the county. Yields range from 100 to more than 500 gallons per minute.

In three inextensive areas, water yields are low. One of these areas is in the southwestern part of the county, east and south of DeGraff; one is east of Bellefontaine; and another is east of Zanesfield. In these areas the glacial drift is thick over bedrock that has a limited supply of water. The area near DeGraff is underlain by limestone bedrock and the other two areas by shale bedrock. Water in these areas is obtained mostly from compact glacial drift. Although a meager 5 to 25 gallons per minute, the yield is sufficient for the households and farmsteads in these areas.

Bellefontaine and the larger villages are served by public water and sewer systems. The water supply for these systems is obtained from wells that penetrate aquifers in deep preglacial valleys that are filled with glacial drift. If developed, some of the aquifers could provide as much as 2,000 gallons or more of water per minute.

Some of the springs and artesian wells in the county emit a strong flow of water. Some of the springs provide water for livestock. A few of the springs and some of the artesian wells provide water for households and farmsteads.

The use of water for irrigating crops is not common in Logan County.

## Transportation facilities

Logan County is well served by hard-surfaced, all-weather highways. U.S. Highway 33 runs through the county northwest and southeast and U.S. Highway 68 north and south. These highways intersect at Bellefontaine, near the center of the county.

State highways intersecting with these larger highways provide access to all parts of the county. State Route 47, running east and west through Bellefontaine, and State Route 235, running north and south in the western part of the county, are the most travelled of the State highways. All county and most township roads are hard-surfaced, all-weather roads.

Two railroad lines provide freight service. The Bellefontaine Municipal Airport provides charter service but does not offer commercial passenger service.

The farm products that are moved off the farm are usually transported by truck, either to a railroad terminal or to a major elevator or market.

### Settlement

The following paragraphs are based on a history of Logan County by Robert P. Kennedy (*7*).

The area now known as Logan County originally was the home of many tribes, or nations, of American Indians. After the defeat of the American Indians at the Battle of Fallen Timbers, the Treaty of Greenville, on August 3, 1795, established a line of demarcation, the Greenville Treaty Line. Lands to the north of this treaty line were reserved for the American Indian, and those to the south were to be opened for settlement.

After the Treaty of Greenville, settlers began to come in great numbers, especially after the War of 1812. Most were from Tennessee, Kentucky, the Carolinas, Pennsylvania, New York, Virginia, and New England. Some were from Europe. Within about three generations the wilderness was overcome. Farms and villages that still exist were established for the production of food and fiber and for commerce.

On March 1, 1805, Champaign County was organized. It originally extended from the south boundary of what is now Clark County northward to Lake Erie. On December 30, 1817, Logan County was formed out of Champaign County by an act of the legislature. It extended from the northern boundary of what is now Champaign County to the Maumee River. In 1820, Bellefontaine was made the county seat. Later, Hardin County was formed out of Logan County, and by 1845 Logan County was fully organized into the present 17 townships.

## How this survey was made

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

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

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

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

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

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

## General soil map for broad land-use planning

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

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

can be identified on the map. Likewise, areas of soils having properties that are distinctly unfavorable for certain land uses can be located.

Because of its small scale, the map does not show the kind of soil at a specific site. Thus, it is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The kinds of soil in any one map unit differ from place to place in slope, depth, stoniness, drainage, or other characteristics that affect their management.

## Soils formed in medium textured and moderately coarse textured glacial deposits on uplands

These soils make up about 33 percent of the county. They are well drained to somewhat poorly drained, nearly level to very steep soils on ground moraines and end moraines. Most areas are farmed. Erosion, seasonal wetness, and moderately slow permeability are the major land-use limitations.

### 1. Crosby-Celina

*Nearly level and gently sloping, somewhat poorly drained and moderately well drained soils formed in medium textured glacial till on ground moraines and undulating parts of end moraines*

This map unit is on ground moraines and undulating end moraines where swells and shallow depressions are evident. Differences in elevation range from about 10 to 30 feet. Slopes are mostly nearly level and gently sloping but are steep in dissected areas along the major drainageways. In an area known as the "Glacial Boulder Belt," in the southwest corner of the county, boulders are piled in fence rows.

This map unit makes up about 3 percent of the county. It is about 40 percent Crosby soils, 20 percent Celina soils, and 40 percent soils of minor extent.

Crosby soils are somewhat poorly drained, medium textured, and nearly level and gently sloping. They are on flats and slight rises. Permeability is slow. The seasonal high water table is between depths of 12 and 36 inches. Celina soils are moderately well drained, medium textured, and nearly level and gently sloping. They are on slightly convex slopes on knolls and ridgetops. Permeability is moderately slow. The seasonal high water table is between depths of 18 and 36 inches. The content of organic matter and available water capacity are moderate in both soils.

The minor soils in this map unit are the very poorly drained Brookston soils in low, concave areas and the well drained Miamian soils on knolls and side slopes along drainageways.

Most areas are used for crops, but a few undrained wet areas are used for pasture or woodland. The main enterprises are cash grain and general farming. The soils have good potential for the cultivated crops commonly grown in the county. They have poor or fair potential for building site development and sanitary facilities because of wetness, moderately slow permeability, the shrink-swell potential, and low strength.

Corn, soybeans, small grain, and hay are the main crops. The main concerns of management are improving drainage, controlling erosion, and maintaining tilth and fertility. Crosby soils dry more slowly in spring than Celina soils. Boulders in the subsoil and substratum in some areas interfere with the placement of subsurface drains.

Celina soils are better suited than Crosby soils to building site development. Both soils are poorly suited to such sanitary facilities as septic tank effluent fields because of the slow or moderately slow permeability.

### 2. Miamian-Crosby

*Nearly level to moderately steep, well drained and somewhat poorly drained soils formed in medium textured glacial till on ground moraines and end moraines*

This map unit consists mainly of nearly level to moderately steep soils on hummocky end moraines where hills, ridges, drainageways, and kettle holes are evident. The soils are steep in a few places along the larger drainageways. Differences in elevation range from about 20 to 70 feet. Slopes are generally uneven and long.

This map unit makes up about 13 percent of the county. It is about 50 percent Miamian soils, 20 percent Crosby soils, and 30 percent soils of minor extent.

Miamian soils are well drained, medium textured, and gently sloping to moderately steep. They are on hills and knolls. Permeability is moderately slow. Organic-matter content is moderate or moderately low. Crosby soils are somewhat poorly drained, medium textured, and nearly level and gently sloping. They are on broad flats and slight rises. Permeability is slow. Organic-matter content is moderate. The seasonal high water table is between depths of 12 and 36 inches.

The minor soils in this map unit are the Brookston and Carlisle soils in swales and low, concave areas and the Celina and Eldean soils on convex knolls.

Most areas are used for cultivated crops, but a few steep areas and a few undrained wet areas are used for permanent pasture or woodland. The main enterprises are cash crops and general farming. The soils have good potential for all cultivated crops commonly grown in the county. Miamian soils have better potential than Crosby soils for building site development and sanitary facilities.

Corn, soybeans, small grain, and hay are the main crops. The main concern of management is control of erosion, especially on the Miamian and Crosby soils. Crosby soils dry out more slowly in spring than Miamian soils and are not so well suited as Miamian soils to grazing early in spring or to crops planted early in spring. Both soils are poorly suited to such sanitary facilities as

septic tank absorption fields because of the slow or moderately slow permeability.

### 3. Miamian

*Gently sloping to very steep, well drained soils formed in medium textured glacial till on end moraines*

This map unit consists mostly of gently sloping to steep soils on hummocky end moraines where ridges and steep drainageways are evident. In some areas along the major streams, the soils are very steep. Differences in elevation range from about 20 to 150 feet. Slopes are generally uneven and long.

This map unit makes up about 10 percent of the county. It is about 60 percent Miamian soils and 40 percent soils of minor extent.

Miamian soils are well drained, medium textured, and gently sloping to very steep. They are on valley walls, knolls, and the crest of hills. Permeability is moderately slow. Organic-matter content is moderate to low.

The minor soils in this map unit are the Berks, Casco, and Rodman soils on ridgetops and side slopes and the Crosby soils on slight rises and flats.

Most of the gently sloping to moderately steep areas are used for cultivated crops, hay, and pasture. The steep and very steep areas are in woodland. The main enterprises are general farming and dairying. The gently sloping and sloping soils have good or fair potential for farming, sanitary facilities, and building site development, but the steep and very steep areas have poor potential for these uses. The potential for woodland and for woodland wildlife habitat is good.

Slope and erosion are the main land-use limitations. The gently sloping and sloping areas are used for corn, soybeans, small grain, hay, and pasture. Including grasses and legumes in the cropping system reduces the risk of erosion. Sanitary facilities, such as septic tank effluent fields, are limited by the slope and the moderately slow permeability.

### 4. Miamian-Eldean

*Nearly level to moderately steep, well drained soils formed in medium textured glacial till and moderately coarse textured glacial outwash on end moraines*

This map unit occurs as hilly areas on end moraines and broad, gently undulating areas where knolls and kettle holes are evident. Differences in elevation range from about 10 to 50 feet. Slopes are nearly level to moderately steep. Most are uneven and long.

This map unit makes up about 7 percent of the county. It is about 45 percent Miamian soils, 20 percent Eldean soils, and 35 percent soils of minor extent.

Miamian soils are well drained, medium textured, and gently sloping to moderately steep. They are on the crest and sides of hills. Permeability is moderately slow. Organic-matter content is moderate or moderately low. Eldean soils are well drained, medium textured, and nearly level to sloping. They are on knolls and broad flats. Permeability is moderate or moderately slow in the subsoil and rapid or very rapid in the substratum. Organic-matter content is moderate or moderately low.

The minor soils in this map unit are the Carlisle soils in kettle holes and swales, the Parr soils on flats and swells, and the Casco soils on hill crests and ridgetops.

Most areas are used for cultivated crops. Some moderately steep areas and areas of the wetter minor soils are used for permanent pasture and woodland. The main enterprises are cash grain and general farming. The potential for recreation uses and building site development is good in the nearly level and gently sloping areas and poor in the moderately steep areas. The potential for woodland and for woodland wildlife habitat is good.

The droughtiness of the Eldean soils and the slope and erosion hazard of both of the major soils are the main land-use limitations. The nearly level and gently sloping areas are well suited to corn, soybeans, small grain, and hay. Under a high level of management, row crops can be grown year after year. The Eldean soils can be seeded early in spring and are well suited to grazing early in spring. Sanitary facilities are limited on the Eldean soils by the possible pollution of underground water supplies.

## Soils formed in moderately fine textured glacial till on uplands

These soils make up about 30 percent of the county. They are poorly drained, somewhat poorly drained, and well drained, nearly level to moderately steep soils on ground moraines and end moraines. Most areas are farmed. Erosion, seasonal wetness, and moderately slow or slow permeability are the major land-use limitations.

### 5. Blount-Wetzel

*Nearly level and gently sloping, somewhat poorly drained and poorly drained soils formed in moderately fine textured glacial till on ground moraines*

This map unit is on undulating ground moraines where swells and shallow depressions are evident. Differences in elevation range from about 10 to 30 feet. Slopes are dominantly short and nearly level and gently sloping, but some areas along drainageways are sloping.

This map unit makes up about 25 percent of the county. It is about 45 percent Blount soils, 30 percent Wetzel soils, and 25 percent soils of minor extent.

Blount soils are somewhat poorly drained, medium textured, and nearly level and gently sloping. They are on broad flats, slight rises, and low knolls. Permeability is slow or moderately slow. Wetzel soils are poorly drained, moderately fine textured, and nearly level. They are in shallow depressions and drainageways. Permeability is moderately slow or slow. Both of the soils have a seasonal high water table near the surface. In both, organic-

matter content and available water capacity are moderate.

The minor soils in this map unit are the Glynwood soils on the crest of knolls and in some of the higher areas and the Pewamo soils in depressions, low, concave areas, and drainageways.

Most areas are used for cultivated crops. A few undrained areas are in pasture or woodland. The main enterprises are cash grain and general farming. The soils have good potential for farming and woodland. The potential is poor for building site development and sanitary facilities and fair or poor for most recreation uses.

The seasonal high water table is the main limitation for most uses. Corn, soybeans, small grain, and hay are the dominant crops. Maintaining tilth in both of the major soils and controlling erosion on the gently sloping Blount soils are important if the soils are farmed. The moderately slow or slow permeability severely limits the use of these soils for sanitary facilities, such as septic tank effluent fields. Low strength limits building site development.

### 6. Blount-Morley

*Nearly level to moderately steep, somewhat poorly drained and well drained soils formed in moderately fine textured glacial till on end moraines*

This map unit is on rolling end moraines where differences in elevation among hill crests, broad swells, and drainageways range from about 10 to 70 feet. Slopes dominantly are long and uneven and nearly level to moderately steep, but some areas along drainageways are steep.

This map unit makes up about 5 percent of the county. It is about 40 percent Blount soils, 20 percent Morley soils, and 40 percent soils of minor extent.

Blount soils are somewhat poorly drained, medium textured, and nearly level and gently sloping. They are on broad flats and slight rises. Permeability is slow or moderately slow. The seasonal high water table is near the surface. Organic-matter content is moderate. Available water capacity also is moderate. Morley soils are well drained, medium textured, and sloping and moderately steep. They are on hillsides and convex ridgetops. Permeability is slow. The seasonal high water table is between depths of 36 and 72 inches. Available water capacity is moderate. Organic-matter content is moderately low.

The minor soils in this map unit are the Glynwood soils on knolls, ridges, and side slopes at the head of drainageways and the Wetzel soils in shallow depressions and drainageways.

Most areas are used for cultivated crops. A few steep areas and some undrained areas are used for permanent pasture or woodland. The main enterprise is general farming. Blount soils have good potential and Morley soils fair or poor potential for cultivated crops. Both soils have poor or fair potential for building site development and sanitary facilities.

Soil wetness and erosion are the main land-use limitations. Erosion is especially a hazard on Morley soils. Corn, soybeans, small grain, and hay are the principal crops. The gently sloping Morley soils are better suited than Blount soils to building site development. Both of these soils are poorly suited to sanitary facilities, such as septic tank effluent fields, because of the slow or moderately slow permeability.

## Soils formed in moderately fine textured and fine textured glacial till on uplands

These soils make up about 16 percent of the county. They are moderately well drained to very poorly drained soils in landscape positions ranging from broad flats on ground moraines to steep areas on end moraines. They are used as cropland, pasture, and woodland. Erosion, seasonal wetness, and moderately slow to very slow permeability are the major land-use limitations.

### 7. Nappanee-Wetzel

*Nearly level and gently sloping, somewhat poorly drained and poorly drained soils formed in moderately fine textured and fine textured glacial till on ground moraines*

This map unit consists of nearly level and gently sloping soils on undulating ground moraines where swells and shallow depressions are evident. In a few areas the soils are along drainageways. Differences in elevation range from about 10 to 30 feet.

This map unit makes up about 3 percent of the county. It is about 60 percent Nappanee soils, 10 percent Wetzel soils, and 30 percent soils of minor extent.

Nappanee soils are somewhat poorly drained, medium textured, and nearly level and gently sloping. They are on broad flats and low knolls. Permeability is very slow. Wetzel soils are poorly drained, moderately fine textured, and nearly level. They are in shallow depressions and in drainageways. Permeability is moderately slow or slow. Both of the soils have a seasonal high water table near the surface. In both, available water capacity and organic-matter content are moderate.

The minor soils in this map unit are the Algiers and Latty soils in low, concave areas and in drainageways, the Haskins soils on slight rises and low knolls, and the St. Clair soils on knolls and along drainageways.

Most areas are used for cultivated crops, but a few undrained areas are used for pasture and woodland. The main enterprise is general farming. Nappanee soils have fair potential and Wetzel soils good potential for cultivated crops. Both soils have poor potential for building site development and sanitary facilities.

The seasonal wetness and the moderately slow to very slow permeability are major land-use limitations. The soils warm up and dry out slowly in spring. The wetness delays planting and limits the choice of crops. Surface

and subsurface drains are commonly used to improve drainage. Drained areas are suited to corn, soybeans, small grain, and hay. The soils can be worked within a narrow range of moisture content.

### 8. Nappanee-Paulding

*Nearly level and gently sloping, somewhat poorly drained and very poorly drained soils formed in dominantly fine textured glacial till on ground moraines and lake plains*

This map unit consists mainly of nearly level and gently sloping soils on undulating ground moraines where swells and shallow depressions are evident. In some areas along drainageways, the soils are sloping. Differences in elevation range from about 10 to 30 feet.

This map unit makes up about 1 percent of the county. It is about 50 percent Nappanee soils, 45 percent Paulding soils, and 5 percent soils of minor extent.

Nappanee soils are somewhat poorly drained, medium textured, and nearly level and gently sloping. They are on broad flats and low knolls. Paulding soils are very poorly drained, fine textured, and nearly level. They are on smooth flats and in shallow depressions. Permeability is very slow in both soils. Both have a seasonal high water table near the surface. In both, available water capacity and organic-matter content are moderate.

The minor soils in this map unit are the St. Clair soils on knolls and along drainageways.

Most areas are used for cultivated crops. Some undrained wet areas are used for pasture and woodland. General farming is the main enterprise. The soils have fair potential for cultivated crops and poor potential for building site development, sanitary facilities, and recreation uses.

The seasonal wetness and very slow permeability of both of the major soils, the ponding on both, and the clayey surface layer of Paulding soils are the main land-use limitations. Surface and subsurface drains are commonly used to lower the water table, but water moves slowly into the subsurface drains. Low strength and a high shrink-swell potential are additional limitations if the soils are used as sites for buildings.

### 9. St. Clair-Nappanee

*Nearly level to steep, moderately well drained and somewhat poorly drained soils formed in fine textured glacial till on end moraines*

This map unit consists mainly of nearly level to moderately steep soils on end moraines where hills and drainageways are evident. In some areas along the larger drainageways, the soils are steep. Differences in elevation range from about 10 to 70 feet. Slopes are generally uneven and long.

This map unit makes up about 12 percent of the county. It is about 40 percent St. Clair soils, 40 percent Nappanee soils, and 20 percent soils of minor extent.

St. Clair soils are moderately well drained, medium textured, and gently sloping to steep. They are on knolls and hills. Permeability is slow or very slow. The seasonal high water table is between depths of 24 and 36 inches. Available water capacity is moderate. Organic-matter content is moderate to low. Nappanee soils are somewhat poorly drained, medium textured, and nearly level and gently sloping. They are on flats and low knolls. Permeability is very slow. The seasonal high water table is near the surface. Available water capacity is moderate. Organic-matter content also is moderate.

The minor soils in this map unit are the Paulding soils in depressions and drainageways.

Many areas are used for cultivated crops. Some steep areas and undrained wet areas are used for permanent pasture and woodland. The main enterprise is general farming. The nearly level to sloping soils have fair potential and the moderately steep and steep soils poor potential for cultivated crops. The potential for building site development and sanitary facilities is poor.

The slow or very slow permeability in both of the major soils, the slope of the St. Clair soils, and the seasonal wetness of the Nappanee soils are the major land-use limitations. The wetness on the Nappanee soils delays planting and limits the choice of crops. The surface layer can be worked within a narrow range of moisture content. It crusts and puddles after heavy rains.

The gently sloping and sloping St. Clair soils are better suited than Nappanee soils as sites for buildings. Both of the soils are poorly suited to sanitary facilities, such as septic tank absorption fields, because of the slow or moderately slow permeability.

## Soils formed in moderately coarse textured to fine textured glacial deposits on outwash terraces, flood plains, and slack water terraces

These soils make up about 14 percent of the county. They are well drained, somewhat poorly drained, and very poorly drained, nearly level to sloping soils, mainly on outwash terraces, flood plains, and slack water terraces. They are used mainly for cultivated crops. Flooding, seasonal wetness, and slow or very slow permeability are the major land-use limitations.

### 10. Eldean-Algiers

*Nearly level to sloping, well drained and somewhat poorly drained soils formed in moderately coarse textured to moderately fine textured sediments on flood plains and outwash terraces*

This map unit consists of nearly level to sloping soils on broad flats on outwash terraces and flood plains that have gentle rises and knolls. Differences in elevation range from about 0 to 20 feet. Slopes generally are short in the gently sloping and sloping areas.

This map unit makes up about 4 percent of the county. It is about 30 percent Eldean soils, 20 percent Algiers soils, and 50 percent soils of minor extent.

Eldean soils are well drained, medium textured, and nearly level to sloping. They are on broad flats, knolls, and slight rises on outwash terraces. Permeability is moderate or moderately slow in the subsoil and rapid or very rapid in the substratum. Available water capacity is low or moderate. Organic-matter content is moderate. Algiers soils are somewhat poorly drained, medium textured, and nearly level. They occur as narrow strips along streams. Permeability is moderate. The seasonal high water table is near the surface. Available water capacity is high. Organic-matter content is moderate.

The minor soils in this map unit are the Carlisle, Linwood, and Lippincott soils in low lying areas and swales; the Gallman and Ockley soils and Wea Variant on broad elevated flats; and the Casco and Rodman soils on slope breaks and hills.

Most areas are farmed. A few undrained wet areas are in woodland. The soils are well suited to corn, soybeans, small grain, and hay. Cash grain and general farming are the main enterprises (fig. 2). The potential for cultivated crops and woodland is good. The potential for building site development is good on Eldean soils and poor on Algiers soils.

Seasonal wetness and flooding on the Algiers soils are the major land-use limitations. Other concerns of management are droughtiness and the hazard of erosion on Eldean soils. The Eldean soils are well suited to early maturing crops and to grazing early in spring. Subsurface drains and open ditches are commonly used to lower the water table in the Algiers soils. If the Eldean soils are used for sanitary facilities, the effluent can pollute underground water supplies.

### 11. Eldean-Lippincott-Montgomery

*Nearly level to sloping, well drained and very poorly drained soils formed in moderately coarse textured to fine textured glacial outwash and lacustrine sediments on outwash plains, kames, and slack water terraces*

This map unit consists mainly of nearly level to sloping soils on broad, flat, uniform outwash plains and glacial lake basins that have gentle rises and knolls. Differences in elevation range from about 0 to 10 feet. The gently sloping and sloping soils generally have short slopes.

This map unit makes up about 10 percent of the county. It is about 20 percent Eldean soils, 15 percent Lippincott soils, 10 percent Montgomery soils, and 55 percent soils of minor extent.

Eldean soils are well drained, medium textured, and nearly level to sloping. They are on broad, slightly elevated flats, gentle rises, and knolls on outwash plains. Permeability is moderate or moderately slow in the subsoil and rapid or very rapid in the substratum. Available water capacity is low or moderate. Organic-matter content is moderate.

Lippincott soils are very poorly drained, moderately fine textured, and nearly level. They occur as broad, low lying areas on outwash plains. Permeability is moderate in the subsoil and rapid in the substratum. The seasonal high water table is near the surface. Organic-matter content is high. Available water capacity is low or moderate.

Montgomery soils are very poorly drained and moderately fine textured. They are in flat or depressional areas on slack water terraces. Permeability is slow or very slow. The seasonal high water table is near the surface. Organic-matter content is high. Available water capacity also is high.

The minor soils in this map unit are the Carlisle and Westland soils in low lying areas and swales.

Most areas are used for corn, soybeans, and small grain. Some areas are used for hay, pasture, and woodland. Cash grain is the main enterprise. The potential for farming and woodland is good. The potential for building site development and recreation uses is good on Eldean soils but poor on Lippincott and Montgomery soils.

The wetness of Lippincott and Montgomery soils and the slow or very slow permeability of Montgomery soils are the major land-use limitations. Other concerns of management are the droughtiness and erosion hazard on Eldean soils. The Eldean soils are well suited to early maturing crops and to grazing early in spring. Subsurface drains and open ditches commonly provide drainage in the Lippincott and Montgomery soils. If Eldean soils are used for sanitary facilities, the effluent can pollute underground water supplies.

## Soils formed in medium textured and fine textured glacial deposits on lakebeds

These soils make up about 7 percent of the county. They are somewhat poorly drained to very poorly drained soils, mainly in basins of glacial lakes. They are used chiefly for cultivated crops. Wetness and slow or very slow permeability are the major land-use limitations.

### 12. Patton Variant-Martisco-Henshaw

*Nearly level and gently sloping, somewhat poorly drained to very poorly drained soils formed in medium textured lake sediments in basins of glacial lakes*

This map unit is in broad, flat, uniform glacial lake basins that have gentle rises. Differences in elevation range from 0 to 5 feet.

This map unit makes up less than 1 percent of the county. It is about 20 percent the Patton Variant, 20 percent Martisco soils, 20 percent Henshaw soils, and 40 percent soils of minor extent.

The Patton Variant consists of poorly drained, medium textured, nearly level soils in depressional areas. Permeability is moderate. Organic-matter content also is moderate. Available water capacity is high. Martisco soils are

very poorly drained and nearly level. They have a surface layer of mucky silt loam and a substratum of marl. Permeability is moderate or moderately rapid in the upper part and slow in the marl. Organic-matter content is very high. Available water capacity is low. Henshaw soils are somewhat poorly drained, medium textured, and nearly level and gently sloping. They are on broad flats and slightly convex knolls. Permeability is moderately slow. Organic-matter content is moderate. Available water capacity is high. In all three of the major soils, the seasonal high water table is near the surface.

The minor soils in this map unit are the Algiers soils and Martisco Variant on flats and in low lying areas and depressions.

Drained areas are used mainly for cultivated crops and undrained areas as habitat for wildlife. Cash grain farming is the main enterprise. The soils have good or fair potential as habitat for wetland wildlife. They have poor potential for building site development and sanitary facilities.

The seasonal wetness and the moderately slow permeability are the major land-use limitations. Surface and subsurface drains are commonly used to improve drainage. The gently sloping Henshaw soils are better suited as sites for buildings than the Patton Variant or the Martisco soils.

### 13. Latty-Fulton

*Nearly level and gently sloping, very poorly drained and somewhat poorly drained soils formed in fine textured lakebed sediments on lake plains*

This map unit consists mainly of nearly level soils in broad, flat, uniform lake basins. In a few areas on slight rises, the soils are gently sloping. Differences in elevation range from about 0 to 10 feet.

This map unit makes up about 6 percent of the county. It is about 50 percent Latty soils, 10 percent Fulton soils, and 40 percent soils of minor extent.

Latty soils are very poorly drained, fine textured, and nearly level. They are on smooth flats and in shallow depressions. Permeability is very slow. Fulton soils are somewhat poorly drained, medium textured, and nearly level and gently sloping. They are on very slight rises. Permeability is slow or very slow. Both of the soils have a seasonal high water table near the surface. In both, available water capacity and organic-matter content are moderate.

The minor soils in this map unit are the Carlisle and Westland soils in the lower lying areas and depressions and the Haskins and Sleeth soils on slight rises.

Most areas are used for cultivated crops. Some undrained wet areas are used for woodland or as habitat for wildlife. Cash grain farming is the main enterprise. The soils have good potential for cultivated crops and poor potential for building site development, sanitary facilities, and recreation uses.

The seasonal wetness and slow or very slow permeability of both of the major soils, the clayey surface layer of Latty soils, and ponding on the Latty soils are the major land-use limitations. Surface and subsurface drains are commonly used to lower the water table, but water moves slowly into the subsurface drains. Low strength and a high shrink-swell potential are additional limitations if the soils are used as sites for buildings.

## Soil maps for detailed planning

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

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

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

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

Soils of one series can differ in texture of the surface layer or in the underlying substratum and in slope, erosion, stoniness, salinity, wetness, or other characteristics that affect their use. On the basis of such differences, a soil series is divided into phases. The name of a *soil phase* commonly indicates a feature that affects use or management. For example, Eldean silt loam, 6 to 12 percent slopes, moderately eroded, is one of several phases within the Eldean series.

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

A *soil complex* consists of areas of two or more soils or of one soil and a land type that are so intricately mixed or so small in size that they cannot be shown

separately on the soil map. Each area includes some of each of the two or more dominant soils, and the pattern and proportion are somewhat similar in all areas. Casco-Eldean complex, 12 to 18 percent slopes, moderately eroded, is an example.

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

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

The acreage and proportionate extent of each map unit are given in table 4, and additional information on properties, limitations, capabilities, and potentials for many soil uses is given for each kind of soil in other tables in this survey. (See "Summary of tables.") Many of the terms used in describing soils are defined in the Glossary.

**Ag—Algiers silt loam.** This deep, nearly level, somewhat poorly drained soil occurs as narrow strips along streams. It is frequently flooded for very brief periods in winter and spring. Slope is 0 to 2 percent. Most areas are long and narrow and range from 30 to 70 acres in size.

Typically, this soil has two layers of recent alluvium over a buried soil. The surface layer is dark brown, firm silt loam about 10 inches thick. The next layer is dark brown, firm silty clay loam about 8 inches thick. The buried soil has a black, firm silty clay loam surface layer about 12 inches thick and a dark gray, mottled, firm silty clay loam subsoil about 12 inches thick. The substratum to a depth of about 60 inches is dark gray, firm silty clay loam.

Included with this soil in mapping are small areas of Shoals and Sloan soils on flood plains and Brookston and Pewamo soils on till plains. Also included are areas where the surface layer and subsoil are mildly alkaline or moderately alkaline.

The seasonal high water table is near the surface in winter and in spring and other extended wet periods. Permeability is moderate. Runoff is very slow. The root zone is deep and has a high available water capacity. It is slightly acid or neutral in the upper part and neutral to moderately alkaline in the lower part. Organic-matter content is moderate. The surface layer can be easily tilled throughout a fairly wide range in moisture content.

Most of the acreage is used for pasture. A few areas are cultivated. This soil has good potential for cultivated crops and woodland and poor potential for building site development and sanitary facilities.

The major limitations of this soil for farming are seasonal wetness and flooding, which delay planting and limit the choice of crops. Undrained areas can be used for hay and pasture, but maintaining tilth and desirable forage stands is difficult unless the soil is drained and grazing is controlled. Drained areas are suited to cultivated crops. Open ditches and subsurface drains are commonly used to lower the water table. Cover crops, incorporation of crop residue into the soil, crop rotations, and tillage at proper moisture levels improve tilth and increase the organic-matter content.

Undrained areas of this soil are suited to woodland and vegetation grown as habitat for wildlife. Species that are tolerant of some wetness should be selected for reforestation. Plant competition can be reduced by spraying, mowing, and disking. The use of harvesting equipment is restricted during wet periods.

The seasonal high water table and the flooding severely limit this soil as a site for buildings and sanitary facilities. The soil has potential for such recreation areas as hiking trails that are used during the drier part of the year. Diking to control flooding is difficult. Local roads can be improved by hauling in fill and suitable base material from other areas.

Capability subclass IIw; woodland suitability subclass 2w.

**BeE—Berks silt loam, 18 to 25 percent slopes.** This moderately deep, steep, well drained soil is in dissected areas on uplands and on valley sides. Most areas are long and narrow and are 5 to 30 acres in size. Slopes range from 400 to 700 feet in length.

Typically, the surface layer is dark grayish brown, friable silt loam about 6 inches thick. The subsoil is about 33 inches thick. The upper part is brown, firm shaly silt loam and silty clay loam; the lower part is strong brown, firm very shaly loam. Strong brown rippable shale bedrock is at a depth of about 39 inches. In some eroded areas the surface layer is shaly silt loam.

Included with this soil in mapping are a few areas of soils that are severely eroded and gullied. The gullies are shallow. Also included are some narrow strips of Miamian soils and the Miamian Variant on the lower part of slopes.

Permeability is moderate or moderately rapid. Runoff is very rapid. The root zone is mainly moderately deep to fractured shale bedrock. Some roots are in the fractures in the bedrock. Available water capacity is low. Organic-matter content also is low. Tilth is good. The subsoil is strongly acid or very strongly acid.

Most of the acreage is woodland or pasture. This soil has poor potential for cultivated crops, building site de-

velopment, and sanitary facilities. It has fair potential for hay, pasture, and woodland.

This soil is severely limited as cropland because it is steep, but it is suited to grasses and legumes for hay and permanent pasture. Erosion is a serious hazard unless adequate plant cover is maintained. The slope limits the operation of machinery and the installation of erosion-control measures. Reseeding pastures and meadows with cover crops or companion crops or by the trash-mulch or no-till seeding methods helps to control erosion. Pasture rotation and restricted use during wet periods keep the pasture and the soil in good condition.

This soil is suited to woodland. Sizable areas support native hardwoods. The slope moderately limits the use of logging equipment. Logging roads and skid trails should be protected against erosion and constructed on the contour if possible.

The steep slope and moderate depth to bedrock severely limit this soil as a site for buildings, sanitary facilities, and recreation uses. Maintaining as much plant cover as possible during construction reduces the erosion hazard. Trails in recreation areas should be protected against erosion and established across the slope if possible.

Capability subclass IVe; woodland suitability subclass 3f.

**BeF—Berks silt loam, 25 to 50 percent slopes.** This moderately deep, very steep, well drained soil is on valley sides in the dissected uplands. Most areas are long and narrow and are 5 to 50 acres in size. Slopes range from 300 to 600 feet in length.

Typically, the surface layer is dark grayish brown, friable silt loam about 2 inches thick. The subsurface layer is light yellowish brown, friable silt loam about 7 inches thick. The subsoil is about 30 inches thick. The upper part is brown, firm shaly silt loam and shaly silty clay loam; the lower part is brown and strong brown, firm very shaly silt loam and very shaly loam. Strong brown rippable shale bedrock is at a depth of about 39 inches.

Included with this soil in mapping are some narrow strips of Miamian soils and the Miamian Variant on the lower part of slopes.

Permeability is moderate or moderately rapid. Runoff is very rapid. The root zone is mainly moderately deep to fractured shale bedrock. Some roots are in the fractures in the bedrock. Available water capacity is low. Organic-matter content also is low. The subsoil is strongly acid or very strongly acid.

Most of the acreage is woodland. This soil has poor potential for building site development, cultivated crops, and recreation uses. It has fair potential for woodland wildlife habitat and for such recreation areas as those used for skiing and hiking. Slope severely limits the use of this soil for hay and pasture. If properly managed, some areas where the slope is 25 to 35 percent are suited to permanent pasture. Erosion is a serious hazard unless adequate plant cover is maintained. Proper stocking rates, pasture rotation, and timely deferment of grazing keep the pasture and the soil in good condition.

This soil is best suited to woodland. The very steep slope severely limits the use of logging equipment. Logging roads should be protected against erosion and laid out on the contour if possible.

Construction for recreation and urban uses is difficult on this soil. The hazard of erosion is very severe if the plant cover is removed. Trails in recreation areas should be protected against erosion and established across the slope if possible.

Capability subclass VIIe; woodland suitability subclass 3f.

**BoA—Blount silt loam, 0 to 2 percent slopes.** This deep, nearly level, somewhat poorly drained soil occurs as broad areas on till plains. Most areas are irregularly shaped and 15 to 300 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsoil is about 31 inches thick. The upper part is yellowish brown, mottled, firm silty clay loam; the next part is yellowish brown, mottled, firm clay; the lower part is grayish brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown, firm clay loam. In some small areas along Mill Creek in Perry Township and northwest of Indian Lake in Stokes Township, the surface layer is loam.

Included with this soil in mapping are small areas of Wetzel and Pewamo soils in depressions.

The seasonal high water table is perched near the surface late in winter, in spring, and in other extended wet periods. Permeability is moderately slow or slow. Runoff is slow. The root zone is mainly moderately deep to compact glacial till. Available water capacity is moderate. Organic-matter content also is moderate. The soil crusts easily after heavy rains. Reaction ranges from medium acid in the upper part of the subsoil to neutral or moderately alkaline in the lower part.

Most areas are used for cultivated crops. This soil has good potential for cultivated crops and woodland and poor potential for building site development and sanitary facilities.

The major limitation of this soil for farming is seasonal wetness, which delays planting and limits the choice of crops. Drained areas are suited to cultivated crops, hay, and pasture. In many areas surface drains remove excess surface water. Subsurface drains are commonly used to lower the perched water table. Minimum tillage, cover crops, incorporation of crop residue into the soil, crop rotations, and tillage at proper moisture levels improve tilth, reduce crusting, and increase the organic-matter content.

If this soil is pastured, overgrazing or grazing during wet periods, when the soil is soft and sticky, causes surface compaction and retards growth. Proper stocking

rates, pasture rotation, and restricted use during wet periods keep the pasture and the soil in good condition.

Undrained areas are suitable as woodland and as habitat for wildlife. Species tolerant of some wetness should be selected in new plantings. Plant competition can be reduced by spraying, mowing, and disking.

The seasonal high water table, the low strength, and the slow or moderately slow permeability severely limit this soil as a site for most sanitary facilities and buildings. The wetness also limits recreation uses. Ditches and subsurface drains can improve drainage. Building sites should be landscaped for good surface drainage away from the foundations. Foundation drains and protective exterior wall coatings help to keep basements dry. Excavations are limited during winter and spring by the seasonal high water table. Sanitary facilities should be connected to central sewers if possible. Local roads can be improved by providing artificial drainage and suitable base material.

Capability subclass IIw; woodland suitability subclass 3o.

**BoB—Blount silt loam, 2 to 6 percent slopes.** This deep, gently sloping, somewhat poorly drained soil occurs as broad areas on till plains. Most areas are irregularly shaped and 10 to 70 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsoil is about 31 inches thick. The upper part is yellowish brown, mottled, friable silty clay loam; the next part is yellowish brown and dark yellowish brown, mottled, firm clay; the lower part is dark yellowish brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown, firm clay loam.

Included with this soil in mapping are small areas of Glynwood soils on slight rises. Also included are areas of Wetzel and Pewamo soils in depressions.

The seasonal high water table is near the surface late in winter, in spring, and in other extended wet periods. Permeability is moderately slow or slow. Runoff is medium. The root zone is mainly moderately deep to compact glacial till. Available water capacity is moderate. Organic-matter content also is moderate. The soil crusts easily after heavy rains. Reaction ranges from medium acid in the upper part of the subsoil to neutral or moderately alkaline in the lower part.

Most areas are used for cultivated crops. This soil has good potential for cultivated crops and woodland and poor potential for building site development and sanitary facilities. It has fair potential for most recreation uses.

This soil is suited to corn, soybeans, wheat, oats, hay, and pasture. Erosion control, wetness, and surface crusting are the main management concerns. Subsurface drainage is commonly used to lower the perched water table. Minimum tillage and incorporation of crop residue or other organic material into the surface layer improve tilth, increase the infiltration rate, and reduce the risk of erosion and surface crusting. Leaving crop residue on the surface in fall and not plowing until spring also help protect the soil against erosion. Tilling or harvesting when the soil is wet and thus soft and sticky causes soil compaction. Crops should be tilled and harvested at optimum moisture levels and with the kind of equipment that minimizes soil compaction. Grassed waterways are needed in some areas.

If this soil is pastured, overgrazing or grazing when the soil is wet and thus soft and sticky causes surface compaction and retards growth. Proper stocking rates, pasture rotation, and restricted use during wet periods keep the pasture and the soil in good condition.

Some areas support native hardwoods. This soil is suited to trees and shrubs that are tolerant of some wetness. Plant competition can be reduced by spraying, mowing, and disking.

The seasonal high water table, low strength, and moderately slow or slow permeability severely limit this soil as a site for most sanitary facilities and buildings. The wetness also limits recreation uses. Ditches and subsurface drains can improve drainage. Landscaping on building sites keeps water away from foundations. The soil is better suited to houses without basements than to houses with basements. Foundation drains and protective exterior wall coatings help to keep basements dry. Sanitary facilities should be connected to central sewers if possible. Local roads can be improved by providing artificial drainage and suitable base material.

Capability subclass IIe; woodland suitability subclass 3o.

**Bs—Brookston silty clay loam.** This deep, nearly level, very poorly drained soil is in low lying or depressional areas and at the head of drainageways on ground moraines and end moraines. It receives runoff from adjacent higher lying soils and is subject to ponding. Most areas are long and narrow and range from 10 to 100 acres in size. Slope is 0 to 2 percent.

Typically, the surface layer is very dark grayish brown, firm silty clay loam about 9 inches thick. It is mottled in the lower 3 inches. The subsoil is about 27 inches thick. The upper part is very dark grayish brown, mottled, firm silty clay loam; the next part is dark grayish brown and gray, mottled, firm clay loam and silty clay loam; the lower part is grayish brown and yellowish brown, mottled, firm silt loam. The substratum to a depth of about 60 inches is yellowish brown, firm loam. It is mottled in the upper part.

Included with this soil in mapping are small areas of Crosby soils on slight rises. Also included are some areas of Algiers soils, which have a lighter colored surface layer than this Brookston soil.

The seasonal high water table is near the surface in winter and spring and in other extended wet periods. Permeability is moderate or moderately slow. Runoff is very slow or ponded. The root zone is moderately deep

or deep to compact glacial till. Available water capacity is high. Organic-matter content also is high. The soil puddles and clods easily. The upper part of the subsoil is slightly acid or neutral, and the lower part is neutral or mildly alkaline.

Most of the acreage is farmed. This soil has good potential for most of the crops commonly grown in the county and for woodland. It has poor potential for building site development, sanitary facilities, and recreation uses.

The very poor natural drainage is the main limitation for farming. Drained areas are well suited to corn, soybeans, wheat, oats, hay, and pasture. In areas that are not adequately drained, stands of wheat and oats are poor in some years. A combination of surface and subsurface drains is commonly used to improve drainage. Tillage within a limited range of moisture content is important because this soil compacts and clods if worked when wet and sticky. Incorporating crop residue or other organic material into the surface layer and planting cover crops help maintain tilth and increase the rate of water infiltration. To prevent compaction, grazing should be limited to periods when the soil is not soft and sticky as a result of wetness.

This soil is suited to trees that can tolerate wetness. Plant competition can be reduced by spraying, mowing, and disking. Wetness limits the use of tree planting and harvesting equipment during winter and spring.

This soil is severely limited as a site for buildings and sanitary facilities by the prolonged wetness, the ponded water, the low strength, and the moderate or moderately slow permeability. Surface drains and storm sewers can remove surface water. Local roads can be improved by providing artificial drainage and suitable base material. Extensive drainage is needed for intensive recreation uses, such as ball diamonds and tennis courts.

Capability subclass IIw; woodland suitability subclass 2w.

**Ca—Carlisle muck.** This deep, nearly level, very poorly drained soil occurs as low areas in bogs and swales on flood plains, terraces, and uplands. It is subject to frequent flooding. Slope is 0 to 2 percent. Most areas are oval and range from 10 to 200 acres in size.

Typically, the surface layer is black, very friable muck about 9 inches thick. Below this to a depth of 60 inches are layers of black, dark brown, very dark brown, very dark gray, and very dark grayish brown, friable muck.

Included with this soil in mapping are narrow strips of Wallkill soils, commonly on the periphery of mapped areas. Also included are small areas of Linwood, Muskego, and Willette soils.

Water is near the surface and ponds for long periods. Permeability ranges from moderately slow to moderately rapid. Runoff is very slow. The root zone is deep and has a very high available water capacity. It is medium acid to mildly alkaline. Organic-matter content is very high. Tilth is good.

This soil is used as cropland and pasture. In a few areas it is used as habitat for wetland wildlife. It has good potential for cropland and pasture and as habitat for wetland wildlife. The potential for building site development, sanitary facilities, and recreation uses is very poor.

The very poor natural drainage and the flooding are limitations for farming. This soil is too wet for crops unless it is drained. Corn is a common crop in drained areas. Surface drains and open ditches can remove ponded water. Subsurface drains can be used in areas where outlets are available. Subsidence or shrinkage occurs as a result of the oxidation of the organic material after the soil is drained. Controlled drainage in areas where the water table can be raised or lowered reduces the amount of shrinkage. During dry periods soil blowing and the risk of fire are major concerns. Planting cover crops, returning crop residue to the soil, irrigating, and establishing windbreaks reduce the risk of soil blowing. Frost damage is an additional management concern because the soil is low on the landscape.

Water-tolerant grasses grown for hay and pasture are suitable in the drained areas of this soil. Overgrazing or grazing when the soil is wet and thus soft and sticky damages plants.

This soil is not well suited to woodland unless it is drained. Undrained areas support water-tolerant trees and some cattails, reeds, or sedges. The wetness seriously limits the use of logging equipment.

Building site development, sanitary facilities, and recreation uses are severely limited by flooding, wetness, low strength, and seepage. Local roads can be improved by removing the organic deposit and replacing it with suitable base material and by providing drainage. This soil is a source of peat for lawns and landscaping. Undrained areas provide good habitat for ducks, muskrats, and other wetland wildlife.

Capability subclass IIIw; woodland suitability subclass 4w.

**Cc—Carlisle muck, ponded.** This deep, nearly level, very poorly drained soil is in low areas. It is ponded much of the year. The depth of ponded water fluctuates with the water level of Indian Lake. Slope is 0 to 2 percent. Most areas are irregularly shaped and 40 to 80 acres in size.

Typically, the surface layer is black, friable muck about 11 inches thick. Below this to a depth of about 60 inches are layers of dark brown and very dark grayish brown, friable muck.

Included with this soil in mapping are narrow strips of Willette soils, commonly on the periphery of mapped areas.

This soil is ponded much of the year, but the water level drops low enough during some of the year for

cattails, sedges, and other water-tolerant plants to grow. Permeability ranges from moderately rapid to moderately slow. The root zone is deep and has a very high available water capacity. It is medium acid to mildly alkaline. Organic-matter content is very high. Tilth is good.

Most areas provide habitat for wetland wildlife. This soil has poor potential for most uses, but has good potential for wetland wildlife habitat.

The ponded water, the seasonal high water table, low strength, and seepage severely limit the use of this soil for farming, building site development, sanitary facilities, woodland, and recreation areas. The fluctuating water level limits the survival of most trees. Most areas are good habitat for duck, muskrat, and other wetland wildlife. Willows are on the margins of the areas.

Capability subclass Vw; not assigned to a woodland suitability subclass.

**CdD2—Casco-Eldean complex, 12 to 18 percent slopes, moderately eroded.** This map unit consists of a deep, somewhat excessively drained Casco soil and a deep, well drained Eldean soil on kames and terraces. Most areas of these hilly soils range from 2 to 10 acres in size. Individual areas are 50 to 60 percent Casco gravelly loam and 30 to 40 percent Eldean loam. The Casco soil is mainly on the sides and tops of the hills, and the Eldean soil is on the lower part of slopes. The two soils are so intricately mixed or are in areas so small that mapping them separately is not practical.

Typically, the Casco soil has a surface layer of dark brown, friable gravelly loam about 5 inches thick. Below this is a friable subsoil about 14 inches thick. The upper part is dark brown gravelly loam; the next part is dark yellowish brown gravelly clay loam; the lower part is dark yellowish brown gravelly sandy loam. The substratum to a depth of about 60 inches is yellowish brown, loose very gravelly sand.

Typically, the Eldean soil has a surface layer of brown, friable loam about 6 inches thick. The subsoil is about 20 inches thick. The upper part is dark brown and yellowish brown, firm gravelly clay; the lower part is dark yellowish brown, firm gravelly clay loam. The substratum to a depth of about 60 inches is brown, loose very gravelly sand.

Included with these soils in mapping are small scattered areas of Rodman soils, mainly on the upper part of slopes.

Permeability is moderate in the subsoil of the Casco soil and moderate or moderately slow in the subsoil of the Eldean soil. It is rapid or very rapid in the substratum of the Eldean soil and very rapid in the substratum of the Casco soil. Runoff is rapid. Available water capacity is low. The root zone is mainly shallow in the Casco soil and is moderately deep to sand and gravel in the Eldean soil. Organic-matter content is low in the Casco soil and moderately low in the Eldean soil. The subsoil of the Casco soil is neutral or mildly alkaline. That of the Eldean soil is medium acid to neutral in the upper part and neutral or mildly alkaline in the lower part.

Most of the acreage is in hay, pasture, or woodland. These soils have poor potential for cultivated crops, building site development, and sanitary facilities. The potential is fair for woodland and fair or poor for pasture.

The moderately steep slope, the erosion hazard, and the low available water capacity limit the use of these soils for farming. Erosion is a serious hazard if the pasture is reseeded or unless adequate plant cover is maintained. Trash-mulch or no-till methods of seeding pasture reduce the risk of erosion and conserve moisture.

These soils are suited to woodland. The use of logging equipment is restricted because of the slope. Establishing seedlings is difficult during extended dry periods.

The moderately steep slope severely limits the use of these soils as sites for buildings and sanitary facilities. Roads and streets should be constructed on the contour if possible. Seepage from sanitary facilities can result in pollution of underground water supplies. Lawns are adversely affected by droughtiness during extended dry periods. Protection against erosion is needed on trails in recreation areas.

Capability subclass VIe; Casco soil in woodland suitability subclass 3s, Eldean soil in woodland suitability subclass 2r.

**CeA—Celina silt loam, 0 to 2 percent slopes.** This deep, nearly level, moderately well drained soil is on slightly convex slopes on ground moraines and end moraines. Most areas are irregularly shaped and range from 5 to 10 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 22 inches thick. The upper part is yellowish brown, firm clay; the lower part is yellowish brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled, calcareous, firm loam. A few small areas are well drained.

Included with this soil in mapping are narrow strips of Crosby and Brookston soils in drainageways and depressions.

The seasonal high water table is perched between depths of 18 and 36 inches late in winter and in spring and other extended wet periods. Permeability is moderately slow. Runoff is slow. The root zone is mainly moderately deep to compact glacial till. Available water capacity is moderate. Organic-matter content also is moderate. Tilth is good. The upper part of the subsoil ranges from strongly acid to neutral and the lower part from slightly acid to mildly alkaline.

Most of the acreage is used for farming. This soil has good potential for cultivated crops, hay, pasture, and woodland and as habitat for openland and woodland wildlife. It has poor or fair potential for building site development and sanitary facilities and fair potential for most recreation uses.

This soil is well suited to corn, soybeans, small grain, hay, and pasture. If the soil is well managed, cultivated crops can be grown frequently. Maintaining good tilth and a high fertility level are the major management concerns. Soil compaction is a problem if the soil is tilled during wet periods, when it is soft and sticky. Minimizing tillage, planting cover crops, incorporating crop residue into the soil, and tilling at proper moisture levels increase the rate of water infiltration and reduce crusting and the risk of erosion. Randomly spaced subsurface drains are needed in the included wetter soils.

If this soil is pastured, overgrazing or grazing when the soil is wet causes compaction and poor tilth. Pasture rotation and restricted grazing during wet periods keep the pasture and the soil in good condition.

Seasonal wetness, the moderately slow permeability, low strength, and the shrink-swell potential limit this soil as a site for buildings and sanitary facilities. Ditches are somewhat effective in controlling the water table. This soil is better suited to houses without basements than to houses with basements. Landscaping on building sites keeps water away from foundations. Foundation drains and protective exterior wall coatings help to keep basements dry. Providing artificial drainage and suitable base material improves local roads by overcoming the risk of damage caused by frost action and low strength.

Capability class I; woodland suitability subclass 1o.

**CeB—Celina silt loam, 2 to 6 percent slopes.** This deep, gently sloping, moderately well drained soil is on convex ridgetops, on side slopes above steeper areas, and on low slopes along waterways. Most areas are irregularly shaped and range from 10 to 100 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 15 inches thick. The upper part is yellowish brown, firm silty clay loam or clay that is mottled below a depth of about 11 inches; the lower part is yellowish brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown, calcareous, firm loam. It is mottled in the upper part. A few small areas are well drained.

Included with this soil in mapping are narrow strips of Crosby soils on the lower part of slopes and in slight depressions.

The seasonal high water table is perched between depths of 18 and 36 inches late in winter and in spring and other extended wet periods. Permeability is moderately slow. Runoff is medium. The root zone is moderately deep to compact glacial till. Available water capacity is moderate. Organic-matter content also is moderate. Tilth is good. The upper part of the subsoil ranges from strongly acid to neutral and the lower part from slightly acid to mildly alkaline.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, and woodland and as habitat for openland and woodland wildlife. It has fair potential for most recreation uses and fair or poor potential for building site development and sanitary facilities.

This soil is well suited to row crops, small grain, and hay. Erosion and surface crusting are the main concerns if the soil is farmed. Including meadow crops in the cropping system and establishing grassed waterways help to control erosion. Incorporating crop residue into the soil, minimizing tillage, planting cover crops, and tilling at proper moisture levels increase the rate of water infiltration and reduce crusting and the risk of erosion. Subsurface drains are needed in the included wetter soils.

The use of this soil for pasture is effective in controlling erosion. Surface compaction, poor tilth, and increased runoff result from overgrazing or grazing during wet periods, when the soil is soft and sticky.

The seasonal wetness, the moderately slow permeability, low strength, and the shrink-swell potential limit this soil as a site for buildings and sanitary facilities. The soil is better suited to houses without basements than to houses with basements. A combination of surface and subsurface drainage can reduce wetness. Foundation drains and protective exterior wall coatings help to keep basements dry. Providing artificial drainage and suitable base material improves local roads by overcoming the risk of damage caused by frost action and low strength. This soil is suited to such recreation uses as picnic areas and paths and trails.

Capability subclass IIe; woodland suitability subclass 1o.

**CrA—Crosby silt loam, 0 to 2 percent slopes.** This deep, nearly level, somewhat poorly drained soil is on slight rises, where it is surrounded by the darker colored Brookston soils, or on extensive upland flats, where it is intermingled with strips of Brookston soils. Most areas are 10 to 80 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsoil is about 29 inches thick. The upper part is dark yellowish brown, mottled, firm silty clay loam; the lower part is yellowish brown and brown, mottled, firm clay. The substratum to a depth of about 60 inches is yellowish brown, calcareous, firm loam.

Included with this soil in mapping are small areas of Brookston soils in drainageways and depressions.

The seasonal high water table is between depths of 12 and 36 inches late in winter and in spring and other extended wet periods. Permeability is slow. Runoff also is slow. The root zone is mainly moderately deep to compact glacial till. Available water capacity is moderate. Organic-matter content also is moderate. Tilth is good. The subsoil is neutral or slightly acid in most areas.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, and wood-

land. It has poor potential for building site development and sanitary facilities and fair or poor potential for recreation uses.

This soil is suited to corn, soybeans, small grain, hay, and pasture. Wetness and surface crusting are the main management concerns if the soil is farmed. Surface drains remove excess surface water in many areas. Subsurface drainage systems lower the water table. Tilling or harvesting when the soil is wet and thus soft and sticky results in soil compaction. Cropped areas should be tilled and crops harvested at optimum moisture levels and with the kind of equipment that minimizes soil compaction. Incorporating crop residue into the soil and planting cover crops reduce crusting and improve tilth.

If this soil is pastured, overgrazing or grazing when the soil is wet causes surface compaction and poor tilth. Pasture rotation and restricted grazing during wet periods keep the pasture and the soil in good condition.

This soil is suited to woodland and to wildlife habitat. The use of harvesting equipment is limited during wet periods. Species that can tolerate some wetness should be selected for new plantings. Reforestation with desirable species is difficult because of plant competition. Survival and growth can be improved by good site preparation.

The seasonal high water table, the slow permeability, and the low strength severely limit the use of this soil as a site for buildings and sanitary facilities. The wetness also limits recreation uses. Landscaping is needed on building sites to keep surface water away from foundations. Sanitary facilities should be connected to central sewers if possible. Providing artificial drainage and suitable base material improves local roads.

Capability subclass IIw; woodland suitability subclass 3o.

**CrB—Crosby silt loam, 2 to 6 percent slopes.** This deep, gently sloping, somewhat poorly drained soil is on low knolls and along drainageways. Most areas are oblong or long and narrow and range from 20 to 300 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. Below this is a mottled, firm subsoil about 22 inches thick. The upper part is yellowish brown silty clay loam; the next part is dark yellowish brown clay; the lower part is yellowish brown loam. The substratum to a depth of about 60 inches is brown, calcareous, firm loam. In some small eroded areas the surface layer is 5 or 6 inches thick.

Included with this soil in mapping are small areas of Brookston soils in small depressions and drainageways. Also included are small areas of Celina soils on convex knolls.

The seasonal high water table is between depths of 12 and 36 inches late in winter and in spring and other extended wet periods. Permeability is slow. Runoff is medium. The root zone is mainly moderately deep to compact glacial till. Available water capacity is moderate. Organic-matter content also is moderate. Tilth is good. The subsoil is neutral or slightly acid in most areas.

Most of the acreage is cropland. This soil has good potential for cropland, pasture, and woodland and as habitat for openland and woodland wildlife. It has fair or poor potential for recreation uses and poor potential for building site development and sanitary facilities.

This soil is suited to corn, soybeans, small grain, hay, and pasture. Erosion control, wetness, and surface crusting are the main management concerns. A subsurface drainage system is commonly used to lower the water table. Grassed waterways, additions of a large amount of crop residue, and a cropping system that includes sod or meadow crops increase the infiltration rate and reduce the risk of erosion and surface crusting. Leaving crop residue on the surface in the fall and not plowing until spring also help to protect the soil against erosion.

The major concerns in pasture management are overgrazing and grazing when the soil is soft and sticky because it is wet. The silt loam surface layer compacts easily; the compaction results in poor tilth and in damage to pastures that are grazed when wet.

This soil is suitable as woodland and as habitat for woodland and openland wildlife. Species that can tolerate some wetness should be selected for new plantings.

The seasonal high water table, the slow permeability, and the low strength severely limit the use of this soil as a site for buildings and sanitary facilities. The wetness also limits recreation uses. Landscaping is needed on building sites to keep surface water away from foundations. Foundation drains and protective exterior wall coatings help to keep basements dry. Sanitary facilities should be connected to central sewers if possible. Providing artificial drainage and suitable base material improves local roads.

Capability subclass IIe; woodland suitability subclass 3o.

**CsA—Crosby-Urban land complex, nearly level.** This map unit consists of a deep, somewhat poorly drained Crosby soil and Urban land on smooth upland flats and slight rises. Slopes range from 0 to 2 percent. Areas are mostly 5 to 20 acres in size. They are 50 to 65 percent Crosby silt loam and 20 to 35 percent Urban land. The Crosby soil and Urban land are so intricately mixed or are in areas so small that mapping them separately is not practical.

Typically, the Crosby soil has a surface layer of dark grayish brown, friable silt loam about 9 inches thick. The subsoil is about 29 inches thick. The upper part is dark yellowish brown, mottled, firm silty clay loam; the lower part is yellowish brown and brown, mottled, firm clay. The substratum to a depth of about 60 inches is yellowish brown, calcareous, firm loam. In places the soil has been radically altered. Some of the low areas have been

filled or leveled during construction, and other small areas have been cut, built up, or smoothed.

The Urban land part of this unit is covered with streets, parking lots, buildings, and other structures that so obscure or alter the soils that identification is not feasible.

About 5 to 10 percent of this unit is small included areas of Brookston soils in shallow depressions and drainageways.

Most areas are artificially drained through sewer systems, gutters, subsurface drains, and, to a lesser extent, surface ditches. In the undrained areas of Crosby soil, the seasonal high water table is between depths of 12 and 36 inches during wet periods.

Permeability is slow or moderately slow through the Crosby soil. Organic-matter content is moderate. Runoff is slow. The root zone is mainly moderately deep to compact glacial till. Available water capacity is moderate. Tilth is fair. The subsoil is neutral or slightly acid in most areas. The shrink-swell potential is moderate.

The Crosby soil, or open part of the map unit, is used for parks, building sites, lawns, and gardens. It has fair potential for lawns, vegetable and flower gardens, trees, and shrubs. It has fair or poor potential for recreation uses and poor potential for building site development and sanitary facilities.

The Crosby soil is suited to grasses, flowers, vegetables, trees, and shrubs if excess water is removed. Several methods of artificial drainage can be successful on this soil. Onsite investigation is needed to determine the best method for a particular area. The perennial plants that are selected for planting should have a fairly high tolerance for wetness. The spots of cut and fill land are not well suited to lawns and gardens. Tilth is poor in exposed subsoil material, which is sticky when wet and hard when dry.

The seasonal high water table, the slow permeability, and the low strength severely limit the use of the Crosby soil as a site for buildings and sanitary facilities. Artificial drainage is needed. Dwellings and small buildings should be constructed without basements and the foundations and footings designed to prevent the structural damage caused by frost action. All sanitary facilities should be connected to central sewers and treatment facilities. Replacing or covering the upper layer of the Crosby soil with suitable base material minimizes maintenance on local roads and streets.

Crosby soil in capability subclass IIw, woodland suitability subclass 3o; Urban land not assigned to a capability subclass or woodland suitability subclass.

**DeA—Del Rey silt loam, 0 to 2 percent slopes.** This deep, nearly level, somewhat poorly drained soil is on broad flats in the basins of former glacial lakes. Most areas are irregularly shaped and range from 10 to 30 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is about 22 inches thick. The upper part is brown, mottled, firm silty clay; the lower part is dark yellowish brown, firm silty clay loam. The substratum to a depth of about 60 inches is dark yellowish brown and yellowish brown, firm silty clay loam.

Included with this soil in mapping are small areas of Montgomery soils in shallow depressions and along drainageways.

The seasonal high water table is between depths of 1 foot and 3 feet in winter and in spring and other extended wet periods. Permeability is slow. Runoff also is slow. The root zone is deep and has a moderate available water capacity. Organic-matter content is moderate. The surface layer crusts or puddles after heavy rains. The subsoil is commonly slightly acid in the upper part and mildly alkaline in the lower part.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, and trees and poor potential for building site development and sanitary facilities.

Seasonal wetness is the main limitation if this soil is cropped. Drained areas are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Cultivated crops can be grown frequently if optimum management is applied. Most cultivated areas have been artificially drained. Subsurface drains are commonly used to remove excess water from the root zone, but water moves slowly into these drains. Soil compaction occurs if areas are tilled or crops are harvested when the soil is soft and sticky because it is wet. Returning crop residue to the soil or adding other organic material and planting cover crops improve tilth, reduce surface crusting, and help to control erosion.

This soil is poorly suited to grazing early in spring because the surface layer is easily compacted when wet. Pasture rotation and restricted grazing during wet periods keep the pasture and the soil in good condition.

Undrained areas of this soil are suited to woodland and to wildlife habitat. Species selected for planting should be tolerant of some wetness. The use of harvesting equipment is limited during wet periods. Reforestation with desirable species is difficult because of plant competition. Survival and growth can be improved by good site preparation.

Seasonal wetness, slow permeability, and low strength limit the use of this soil as a site for buildings and sanitary facilities. Landscaping is needed on building sites to keep surface water away from foundations. Drainage ditches and subsurface drains are commonly used to improve drainage. Foundations should be designed to prevent the structural damage caused by frost action and by shrinking and swelling. Excavations are limited by wetness during winter and spring. Providing artificial drainage and suitable base material improves local roads.

Capability subclass IIw; woodland suitability subclass 3o.

**DeB—Del Rey silt loam, 2 to 6 percent slopes.** This deep, gently sloping, somewhat poorly drained soil is on convex knolls in basins of former glacial lakes. Most areas are irregularly shaped and range from 5 to 20 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is yellowish brown, mottled, firm silty clay about 20 inches thick. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm silty clay loam.

Included with this soil in mapping are small areas of very poorly drained Montgomery soils in shallow depressions and along drainageways. Also included, on the upper part of slopes, are eroded areas where the surface layer is silty clay loam.

The seasonal high water table is between depths of 1 foot and 3 feet in winter and in spring and other extended wet periods. Permeability is slow. Runoff is medium. The surface layer can be easily tilled throughout a fairly wide range in moisture content, but it crusts or puddles after heavy rains. Organic-matter content is moderate. The root zone is deep and has a moderate available water capacity. The upper part of the subsoil is commonly slightly acid and the lower part mildly alkaline.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. The potential for building site development and sanitary facilities is poor.

This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Seasonal wetness and erosion are the main limitations if the soil is cropped. Most cropped areas are drained by randomly spaced subsurface drains, but water moves slowly into these drains. Minimum tillage, cover crops, and grassed waterways help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, reduces crusting, and increases the rate of water intake.

The major concerns in pasture management are overgrazing and grazing when the soil is soft and sticky because it is wet. The soil is poorly suited to grazing early in spring. It compacts easily, the compaction resulting in poor tilth, increased runoff, and damage to pastures that are grazed when wet or are overgrazed. Pasture rotation and restricted grazing during wet periods keep the pasture and the soil in good condition.

Undrained areas are suited to woodland and to wildlife habitat. Species tolerant of some wetness should be selected for planting. The use of harvesting equipment is limited during wet periods. Reforestation with desirable species is difficult because of plant competition. Survival and growth can be improved by good site preparation.

Seasonal wetness, slow permeability, and low strength limit the use of this soil as a site for buildings and sanitary facilities. Subsurface drains and open ditches can improve drainage. Landscaping is needed on building sites to keep surface water away from foundations. Foundations should be designed to prevent the structural damage caused by frost action and by shrinking and swelling. Wetness limits excavation during winter and spring. Providing artificial drainage and suitable base material improves local roads.

Capability subclass IIe; woodland suitability subclass 3o.

**Ed—Edwards muck.** This deep, nearly level, very poorly drained soil is in bogs and swales on outwash plains and till plains and in lake basins. It is subject to frequent flooding. Slope is 0 to 2 percent. Most areas are circular and range from 5 to 150 acres in size.

Typically, the surface layer is black, friable muck about 16 inches thick. The subsurface layer, to a depth of about 26 inches, also is black, friable muck. The substratum to a depth of about 60 inches is white and light gray, friable marl. It is mottled in the upper part.

Included with this soil in mapping are small areas of Martisco soils and the Martisco Variant.

Water is near the surface and ponds for long periods. Runoff is very slow. Permeability is moderately rapid to moderately slow in the organic layers and varies in the marl. The root zone is mainly moderately deep, extending to the marl, and has a moderate to very high available water capacity. It ranges from medium acid to mildly alkaline. Organic-matter content is very high. Tilth is good.

Most of the acreage is cropland or pasture. A few areas provide habitat for wildlife. This soil has fair potential for cropland and pasture and good potential as habitat for wetland wildlife. The potential for building site development and sanitary facilities is poor.

The very poor natural drainage, the flooding, and the marl at a depth of 16 to 45 inches are the major limitations if this soil is farmed. If drained, the soil is suited to cropland. Cultivated crops can be grown year after year if optimum management practices are applied. Surface drains are commonly used to remove ponded water. Subsurface drains also are used if outlets are available. Draining some areas is difficult because adequate outlets are not available. This soil is subject to subsidence or shrinkage in drained areas. Controlled drainage in areas where the water level can be raised or lowered reduces the shrinkage. When dry, this soil is subject to soil blowing. Winter cover crops, irrigation, and windbreaks reduce the risk of soil blowing.

This soil is suited to water-tolerant grasses grown for hay and pasture. Pastures can be damaged by overgrazing and by grazing when the soil is soft and sticky because it is wet.

This soil is generally not suited to woodland unless it is drained. Undrained areas support water-tolerant trees and some cattails, reeds, or sedges.

Building site development and sanitary facilities are severely limited by flooding, wetness, and low strength. Undrained areas provide good habitat for ducks, muskrat, and other wetland wildlife.

Capability subclass IVw; woodland suitability subclass 4w.

**Ee—Eel silt loam.** This deep, nearly level, moderately well drained soil is on flood plains. It is commonly flooded for brief periods in fall, winter, and spring. Most areas are long and narrow and range from about 10 to 70 acres. Slope is 0 to 2 percent.

Typically, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsoil is about 29 inches thick. The upper part is dark brown and brown, friable silt loam or firm silty clay loam that is mottled below a depth of about 13 inches; the lower part is dark yellowish brown and yellowish brown, mottled, firm silty clay loam. The substratum to a depth of about 60 inches is brown and dark grayish brown, firm silty clay loam.

Included with this soil in mapping are small areas of Shoals soils in shallow depressions.

The seasonal high water table is at a depth of 36 to 72 inches in winter and spring. Permeability is moderate. Runoff is slow. The root zone is deep and has a high available water capacity. Organic-matter content is moderate. The surface layer can be easily tilled throughout a fairly wide range in moisture content. Reaction is neutral to moderately alkaline throughout.

This soil is used for cropland, pasture, and woodland. It has good potential for cropland, pasture, and woodland and poor potential for building site development and sanitary facilities.

Flooding is the major hazard if this soil is farmed. The soil is well suited to corn and soybeans. Flooding late in winter and in spring can severely damage winter grain unless the crop is protected from floodwater. Cover crops and crop residue maintain organic-matter content, reduce crusting, and protect the surface in areas that are subject to scouring during floods. Randomly spaced subsurface drains are needed in some of the included areas of wetter soils.

This soil is suited to grasses and legumes for pasture. Compaction and poor tilth can result if the pasture is overgrazed or grazed when the soil is soft and sticky because it is wet. Pasture rotation and deferment of grazing during wet periods keep the pasture and the soil in good condition.

This soil is well suited to trees and other vegetation grown as habitat for wildlife. Spraying, mowing, and disking reduce plant competition.

The flood hazard and the seasonal high water table seriously limit this soil as a site for buildings and sanitary facilities. This soil has potential for recreation uses, such as picnic areas, hiking trails, and golf fairways. Diking to control flooding is difficult. Filling elevates roads above normal flood levels. This soil is a good source of topsoil.

Capability subclass IIw; woodland suitability subclass 1o.

**EmA—Eldean silt loam, 0 to 2 percent slopes.** This deep, nearly level, well drained soil is on broad flats on outwash plains and valley trains. Most areas are irregularly shaped and range from 5 to 100 acres in size.

Typically, the surface layer is dark brown, friable silt loam about 7 inches thick. The subsoil is about 27 inches thick. The upper part is dark brown and brown, firm clay, clay loam, and gravelly sandy clay; the lower part is brown, firm gravelly clay loam and loose gravelly coarse sandy loam. The substratum to a depth of about 60 inches is brown, calcareous, loose gravelly sand.

Included with this soil in mapping are small areas of Ockley soils on terraces and Miamian soils near breaks to the uplands.

Permeability is moderate or moderately slow in the subsoil and rapid or very rapid in the substratum. Runoff is slow. The root zone is mainly moderately deep to sand and gravel and has a low or moderate available water capacity. Organic-matter content is moderate. The surface layer can be easily tilled throughout a fairly wide range in moisture content. The upper part of the subsoil is medium acid to neutral, and the lower part is neutral or mildly alkaline.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, trees, and building site development.

This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Droughtiness is the main limitation on cropland. Crops can be seeded early because the soil warms and dries early in spring. Row crops can be grown year after year if a high level of management is applied. The soil is well suited to irrigation. Returning crop residue to the soil or regularly adding other organic material and minimizing tillage reduce crusting and increase the rate of water intake.

Compaction and poor tilth can result if pasture is overgrazed or grazed when the soil is soft and sticky because it is wet. Pasture rotation and deferment of grazing during wet periods keep the pasture and the soil in good condition.

Even though only a small acreage is wooded, this soil is well suited to woodland. Plant competition can be reduced by spraying, mowing, or disking.

Although low strength and the shrink-swell potential are moderate limitations, this soil is well suited to building site development (fig. 3). The low strength can be overcome by extending the building foundation to the substratum. Local roads can be improved by replacing the subsoil with suitable base material. If sanitary facilities are installed on this soil, the effluent can pollute underground water supplies. Lawns are adversely affected by droughtiness during dry periods. This soil is a good source of sand and gravel.

Capability subclass IIs; woodland suitability subclass 2o.

**EmB—Eldean silt loam, 2 to 6 percent slopes.** This deep, gently sloping, well drained soil is on outwash plains and valley trains. Most areas are irregularly shaped and range from 10 to 40 acres in size.

Typically, the surface layer is dark brown, friable silt loam about 6 inches thick. The subsoil is about 19 inches thick. The upper part is reddish brown, firm clay; the lower part is brown, firm gravelly clay loam and friable gravelly sandy loam. The substratum to a depth of about 60 inches is brown, calcareous, loose gravelly sand.

Included with this soil in mapping are small areas of Miamian soils on slope breaks to the uplands.

Permeability is moderate or moderately slow in the subsoil and rapid or very rapid in the substratum. Runoff is medium. The root zone is mainly moderately deep to sand and gravel and has a low or moderate available water capacity. Organic-matter content is moderate. The surface layer can be easily tilled throughout a fairly wide range in moisture content. The upper part of the subsoil is medium acid to neutral, and the lower part is neutral or mildly alkaline.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, trees, and building site development.

This soil is well suited to corn, soybeans, and small grain (fig. 4) and to grasses and legumes for hay or pasture. Droughtiness and erosion are the main management concerns. Because of the limited available water capacity, the soil is better suited to early maturing crops than to crops that mature late in summer. Minimizing tillage, planting cover crops, and establishing grassed waterways help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, reduces crusting, and increases the rate of water intake.

The use of the soil for pasture or hay is effective in controlling erosion. Surface compaction, excessive runoff, and poor tilth, however, can result if the pasture is overgrazed or grazed when the soil is soft and sticky because it is wet. Pasture rotation, timely deferment of grazing, and restricted use during wet periods keep the pasture and the soil in good condition.

Even though only a small acreage is wooded, this soil is well suited to woodland. Plant competition can be reduced by spraying, mowing, or disking.

Although low strength and the shrink-swell potential are moderate limitations, this soil is well suited to building site development (fig. 5). The low strength can be overcome by extending building foundations to the substratum. Local roads can be improved by replacing the subsoil with suitable base material. If sanitary facilities are installed on this soil, the effluent can pollute underground water supplies. Lawns are adversely affected by droughtiness during dry periods. This soil is a good source of sand and gravel.

Capability subclass IIe; woodland suitability subclass 2o.

**EmC2—Eldean silt loam, 6 to 12 percent slopes, moderately eroded.** This deep, sloping, well drained soil is on outwash plains, kames, and moraines. Most areas are long and narrow or irregularly shaped and range from 10 to 20 acres in size.

Typically, the surface layer is brown, friable silt loam about 5 inches thick. The subsoil is about 17 inches thick. The upper part is dark brown, firm clay; the lower part is friable, pale brown gravelly loam. The substratum to a depth of about 60 inches is brown, calcareous, loose gravelly sand.

Included with this soil in mapping are small areas of Casco soils on the upper part of slopes. Also included are some severely eroded areas where the surface layer is clay loam and tilth is poor.

Permeability is moderate or moderately slow in the subsoil and rapid or very rapid in the substratum. Runoff is rapid. The root zone is mainly moderately deep to sand and gravel and has a low available water capacity. Organic-matter content is moderately low. The upper part of the subsoil is medium acid to neutral, and the lower part is neutral or mildly alkaline.

Most of the acreage is farmed. This soil has fair potential for cultivated crops, building site development, and recreation uses. It has good potential for hay, pasture, and trees.

Erosion is the main hazard if cultivated crops are grown on this soil. During extended dry periods the soil is droughty. Because of the limited amount of water available to plants, it is better suited to early maturing crops than to crops that mature late in summer. Minimizing tillage, planting cover crops, and establishing grassed waterways reduce runoff and soil loss. Incorporating crop residue or other organic material into the surface layer improves tilth, increases the infiltration rate, and reduces crusting.

Including long term hay and pasture plants in the cropping system reduces the erosion hazard. Overgrazing or grazing during wet periods, when the soil is soft and sticky, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and restricted use during wet periods keep the pasture and the soil in good condition.

This soil is well suited to trees. A few small areas support native hardwoods. Plant competition can be reduced by spraying, mowing, and disking.

The slope, the low strength, the shrink-swell potential, and the possible pollution of underground water supplies limit this soil as a site for buildings, sanitary facilities, and most recreation uses. If the soil is used as a construction site, development should be on the contour if possible. The low strength can be overcome by extending building

foundations to the substratum. Local roads can be improved by replacing the subsoil with suitable base material. Lawns are adversely affected by droughtiness during dry periods. Trails in recreation areas should be protected against erosion and established across the slope if possible. This soil is a good source of sand and gravel.

Capability subclass IIIe; woodland suitability subclass 2o.

**EpB—Eldean-Urban land complex, undulating.** This map unit consists of a deep, undulating, well drained Eldean soil on outwash plains and Urban land. Most areas range from 50 to 200 acres in size. They are about 50 to 65 percent Eldean silt loam and 20 to 35 percent Urban land. The Eldean soil and Urban land are so intricately mixed or are in such small areas that mapping them separately is not practical. Slopes range from 1 to 8 percent.

Typically, the Eldean soil has a surface layer of dark brown, friable silt loam about 7 inches thick. The subsoil is about 23 inches thick. The upper part is brown, firm clay loam and clay; the lower part is brown, firm gravelly clay loam and gravelly sandy loam. The substratum to a depth of about 60 inches is brown, calcareous, loose gravelly sand. In places the soil has been radically altered. Some of the low areas have been filled or leveled during construction, and other small areas have been cut, built up, or smoothed.

The Urban land part of this unit is covered with streets, parking lots, buildings, and other structures that so obscure or alter the soils that identification is not feasible.

About 10 to 20 percent of this unit is small included areas of Ockley soils on outwash plains and Miamian soils on slope breaks to the uplands.

Permeability is moderate or moderately slow in the subsoil of the Eldean soil and rapid or very rapid in the substratum. Organic-matter content is moderate. The root zone is mainly moderately deep to sand and gravel and has a low or moderate available water capacity. Runoff is slow or medium. The upper part of the subsoil is medium acid to neutral, and the lower part is neutral or mildly alkaline.

The Eldean soil, or open part of the map unit, is used for parks, building sites, lawns, and gardens. It has good potential for lawns, vegetable and flower gardens, trees, and shrubs and for recreation areas and building site development.

The Eldean soil is suited to grasses, flowers, vegetables, trees, and shrubs. During dry periods supplemental irrigation is needed to promote good growth. Erosion generally is not a major problem unless the soil is disturbed and left unprotected. The spots of cut and fill are not well suited to lawns and gardens. Tilth is poor in the exposed subsoil material, which is sticky when wet and hard when dry.

The Eldean soil is well suited to building site development, but the low strength and the shrink-swell potential are moderate limitations. The low strength can be overcome by extending building foundations to the substratum. Local roads can be improved by replacing the subsoil with suitable base material. If the soil is used as a site for sanitary facilities, the effluent can pollute underground water supplies.

Eldean soil in capability subclass IIe, woodland suitability subclass 2o; Urban land not assigned to a capability subclass or a woodland suitability subclass.

**FlA—Fox loam, 0 to 2 percent slopes.** This deep, nearly level, well drained soil is on slight rises on outwash plains. Most areas are round or long and narrow and are 15 to 60 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 8 inches thick. The subsoil is about 28 inches thick. The upper part is dark yellowish brown or dark brown, firm sandy clay loam and gravelly clay loam; the lower part is yellowish brown, friable gravelly sandy loam. The substratum to a depth of about 60 inches is brown, calcareous, loose gravelly sand.

Permeability is moderate in the subsoil and very rapid in the substratum. Runoff is slow. The root zone is mainly moderately deep and has a low or moderate available water capacity. Organic-matter content is moderate. The surface layer can be easily tilled throughout a fairly wide range in moisture content. The upper part of the subsoil is slightly acid or neutral, and the lower part is neutral or mildly alkaline.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, trees, building site development, and recreation uses.

This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. The major management concern is conserving moisture, but maintaining a high level of fertility and a sufficient amount of crop residue is a related concern. Because of the limited amount of water available to plants, the soil is better suited to early maturing crops than to crops that mature late in summer. It is suited to irrigation. Minimizing tillage, returning crop residue to the soil, and including sod crops in the cropping sequence reduce crusting and increase the rate of water intake.

This soil is well suited to grazing early in spring. Overgrazing or grazing during wet periods, when the soil is soft and sticky, causes compaction and poor tilth. Pasture rotation and deferment of grazing during wet periods keep the pasture and the soil in good condition.

This soil is suited to woodland, but only a small acreage supports trees. Plant competition can be reduced by spraying, mowing, and disking.

Even though the shrink-swell potential and the low strength are moderate limitations, this soil is suited to building site development. These limitations can be partly overcome by extending foundations to the underly-

ing sand and gravel and by backfilling with suitable material. Local roads can be improved by providing suitable base material. The possible contamination of ground water limits the use of this soil as a site for some sanitary facilities. Lawns are adversely affected by droughtiness during extended dry periods. The soil is well suited to recreation uses. It is a good source of sand and gravel.

Capability subclass IIs; woodland suitability subclass 2o.

**FlB—Fox loam, 2 to 6 percent slopes.** This deep, gently sloping, well drained soil is on knolls and short, uneven side slopes on outwash plains. Most areas are round or long and narrow and range from 10 to 80 acres.

Typically, the surface layer is dark grayish brown, friable loam about 8 inches thick. The subsoil is about 28 inches thick. The upper part is brown, friable loam over dark yellowish brown, firm sandy clay loam; the lower part is dark brown, firm gravelly clay loam over yellowish brown, friable gravelly sandy loam. The substratum to a depth of about 60 inches is brown, calcareous, loose gravelly sand.

Permeability is moderate in the subsoil and very rapid in the substratum. Runoff is medium. The root zone is mainly moderately deep to sand and gravel and has a low or moderate available water capacity. Organic-matter content is moderate. The surface layer can be easily tilled throughout a fairly wide range in moisture content. The upper part of the subsoil is slightly acid or neutral, and the lower part is neutral or mildly alkaline.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, trees, building site development, and most recreation uses.

This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay. Droughtiness and erosion are the main management concerns. Because of the limited amount of water available to plants, the soil is better suited to early maturing crops than to crops that mature late in summer. It is well suited to irrigation. Minimizing tillage, planting cover crops, and establishing grassed waterways help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, reduces crusting, and increases the rate of water intake.

This soil is well suited to grazing early in spring. Overgrazing or grazing during wet periods, when the soil is soft and sticky, causes surface compaction and poor tilth. Pasture rotation and deferment of grazing during wet periods keep the pasture and the soil in good condition.

This soil is suited to woodland, but only a few areas are wooded. Plant competition can be reduced by spraying, mowing, and disking.

Even though the shrink-swell potential and the low strength are moderate limitations, this soil is suited to building site development. These limitations can be overcome by extending foundations to the underlying sand and gravel and by backfilling with suitable material. Local roads can be improved by providing suitable base material. Lawns are adversely affected by droughtiness during extended dry periods. The possible contamination of ground water limits the use of this soil as a site for some sanitary facilities. The soil is well suited to recreation uses. It is a good source of sand and gravel.

Capability subclass IIe; woodland suitability subclass 2o.

**FuA—Fulton silt loam, 0 to 4 percent slopes.** This deep, nearly level and gently sloping, somewhat poorly drained soil is on very slight rises in basins of former glacial lakes. Most areas are circular or long and narrow and range from 5 to 10 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is dark yellowish brown and yellowish brown, firm silty clay about 34 inches thick. It is mottled to a depth of about 29 inches. The substratum to a depth of about 60 inches is yellowish brown, calcareous, firm clay.

Included with this soil in mapping are small areas of Latty soils in shallow depressions and drainageways.

The water table is near the surface in winter and in spring and other extended wet periods. Permeability is slow or very slow. Runoff is slow or medium. The root zone is moderately deep or deep to the compact substratum. Available water capacity is moderate. Organic-matter content also is moderate. The soil can be worked within a narrow range in moisture content. The upper part of the subsoil is strongly acid to neutral, and the lower part is slightly acid to mildly alkaline.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. The potential for building site development and sanitary facilities is poor.

This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay or pasture. Seasonal wetness is the main limitation if the soil is cropped. Subsurface drains commonly provide drainage. They are supplemented by surface drains in some areas. Water moves slowly into subsurface drains. The soil puddles and clods if it is worked during wet periods, when it is soft and sticky. Returning crop residue to the soil or regularly adding other organic material and planting cover crops reduce crusting, improve tilth, and increase the rate of water infiltration.

This soil is suited to pasture or hay but is poorly suited to grazing early in spring. Surface compaction, poor tilth, and a decreased infiltration rate result from overgrazing or from grazing during wet periods, when the soil is soft and sticky. Plant selection, pasture rotation, and timely deferment of grazing keep the pasture and the soil in good condition.

This soil is suited to trees that are tolerant of some wetness and can survive in spite of the clayey subsoil. A

few areas support native hardwoods. Seedlings of suitable species survive and grow well if competing vegetation is controlled or removed by spraying, mowing, or disking.

The seasonal high water table, the shrink-swell potential, and the slow or very slow permeability severely limit this soil as a site for most sanitary facilities and for buildings. The wetness also limits recreation uses. Providing artificial drainage and suitable base material improves local roads. Landscaping is needed on building sites to keep surface water away from foundations. Sanitary facilities should be connected to commercial sewers if possible.

Capability subclass IIIw; woodland suitability subclass 3c.

**GaB—Gallman loam, 1 to 4 percent slopes.** This deep, gently sloping, well drained soil is on outwash plains. Most areas are irregularly shaped and range from 10 to 20 acres in size.

Typically, the surface layer is brown, friable loam about 8 inches thick. The subsoil to a depth of about 75 inches is, in sequence downward, brown, friable and firm loam; brown, firm clay loam; dark yellowish brown, firm shaly clay loam; and brown, friable gravelly loam.

Included with this soil in mapping are small areas of the Wea Variant in the lower positions on the landscape and some areas where the surface layer is gravelly loam. Also included are some areas where the lower part of the subsoil is 40 to 60 percent gravel and a sand and gravel substratum that is rapidly or very rapidly permeable is evident.

Permeability is moderately rapid in this Gallman soil. Runoff is slow or medium. The root zone is deep and has a moderate available water capacity. Organic-matter content is moderate. The surface layer can be easily tilled throughout a fairly wide range in moisture content. The upper part of the subsoil ranges from very strongly acid to neutral and the lower part from slightly acid to mildly alkaline.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, trees, building site development, and recreation uses.

This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay or pasture. Because of the limited amount of water available to plants, it is better suited to early maturing crops than to crops that mature late in summer. The soil dries early in spring and is well suited to irrigation. Row crops can be grown year after year if erosion is controlled. Erosion is the main hazard if cultivated crops are grown. Minimizing tillage, planting cover crops, and establishing grassed waterways reduce the risk of erosion. Returning crop residue to the soil or regularly adding other organic material improves fertility, reduces crusting, and increases the rate of water intake.

This soil is well suited to grazing early in spring. Overgrazing or grazing during wet periods, when the soil is soft and sticky, causes surface compaction, excessive runoff, and poor tilth. Pasture rotation and restricted use during wet periods keep the pasture and the soil in good condition. Pastures and meadows of shallow-rooted legumes and grasses tend to dry out during periods when rainfall is below normal.

This soil is well suited to trees. A few small areas remain in native hardwoods. Seedlings survive and grow well if competing vegetation is controlled or removed by spraying, mowing, or disking.

This soil is well suited as a site for buildings, but the low strength is a moderate limitation. Local roads and streets can be improved by providing suitable base material. Because of seepage, the effluent from sanitary facilities, especially from trench sanitary landfills, can pollute underground water supplies. This soil is well suited to recreation uses.

Capability subclass IIe; woodland suitability subclass 1o.

**Gn—Genesee silt loam.** This deep, nearly level, well drained soil is in the highest position on flood plains. It is commonly flooded for brief periods in fall, winter, and spring. Most areas are long and narrow and range from 20 to 100 acres or more in size. Slope is 0 to 2 percent.

Typically, the surface layer is dark brown, friable silt loam about 10 inches thick. The substratum to a depth of about 60 inches is brown and dark yellowish brown, friable silt loam.

Included with this soil in mapping are narrow strips of Eel soils at a slightly lower elevation on the flood plains.

Permeability is moderate. Runoff is slow. The root zone is deep and has a high available water capacity. Organic-matter content is moderate. The surface layer can be easily tilled throughout a fairly wide range in moisture content. Reaction is mildly alkaline or moderately alkaline throughout the soil.

This soil is used for cropland, pasture, and woodland. It has good potential for cropland, pasture, and woodland and poor potential for building site development and sanitary facilities.

Flooding is the main hazard if this soil is cropped. Although the choice of crops is limited, the soil is well suited to corn and soybeans. Such a crop as winter wheat is severely damaged by floodwaters in winter and early in spring. In most years row crops can be planted and harvested during periods when flooding does not occur. Cover crops and crop residue maintain the organic-matter content, reduce crusting, and protect the surface during floods.

This soil is suited to grasses and legumes for pasture. Overgrazing or grazing during wet periods, when the soil is soft and sticky, causes compaction and poor tilth. Pasture rotation and deferment of grazing during wet periods keep the pasture and the soil in good condition.

This soil is well suited to trees and other vegetation grown as habitat for wildlife. Tree seedlings grow well if competing vegetation is controlled or removed by spraying, mowing, or disking.

Flooding seriously limits this soil as a site for most buildings and sanitary facilities. The soil has potential for recreation uses, such as picnic areas, hiking trails, and golf fairways. Diking to control flooding is difficult. Filling elevates roads above normal flood levels.

Capability subclass IIw; woodland suitability subclass 1o.

**GwB—Glynwood silt loam, 2 to 6 percent slopes.** This deep, gently sloping, moderately well drained soil is on the knolls, ridges, and side slopes at the head of drainageways on ground moraines and end moraines. Most areas are irregularly shaped and 10 to 50 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is about 31 inches thick. The upper part is yellowish brown and dark yellowish brown, firm silty clay loam or clay that is mottled below a depth of 16 inches; the lower part is yellowish brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown, firm clay loam.

Included with this soil in mapping are small areas of Blount soils on toe slopes and foot slopes and on nearly level parts of the landscape and small areas, on the upper part of slopes, of an eroded soil that has a silty clay loam surface layer. Also included are Pewamo and Wetzel soils in narrow drainageways.

The seasonal high water table is perched between depths of 18 and 36 inches in winter and in spring and other extended wet periods. Permeability is slow. Runoff is medium. The root zone is mainly moderately deep to compact glacial till. Available water capacity is moderate. Organic-matter content also is moderate. The soil crusts easily after heavy rains. The upper part of the subsoil ranges from strongly acid to neutral and the lower part from slightly acid to moderately alkaline.

This soil is used principally as cropland. It has good potential for most of the crops commonly grown in the county and for woodland. The potential for building site development, sanitary facilities, and most recreation uses is fair or poor.

This soil is suited to corn, soybeans, small grain, and grasses and legumes. Erosion is the main hazard if cultivated crops are grown. Minimum tillage, cover crops, and grassed waterways reduce the risk of erosion. Incorporating crop residue or other organic material into the surface layer improves tilth, increases the infiltration rate, and reduces crusting. Randomly spaced subsurface drains are needed in the wetter included soils.

The use of this soil as pasture is effective in controlling erosion. Surface compaction, reduced growth, and increased runoff result from overgrazing and from grazing during wet periods, when the soil is soft and sticky. Proper stocking rates, plant selection, pasture rotation, and restricted use during wet periods keep the pasture and the soil in good condition.

This soil is well suited to trees. A few small areas support native hardwoods. Seedlings survive and grow well if competing vegetation is controlled or removed. Survival and growth can be improved by good site preparation.

The seasonal wetness, the slow permeability, and the shrink-swell potential moderately limit this soil as a site for buildings and sanitary facilities. The soil is better suited to houses without basements than to houses with basements. Providing artificial drainage and suitable base material improves local roads. The soil is suited to such recreation areas as picnic areas and hiking trails. It is also suitable for pond embankments.

Capability subclass IIe; woodland suitability subclass 2o.

**HdA—Haskins loam, 0 to 2 percent slopes.** This deep, nearly level, somewhat poorly drained soil is on terraces and outwash plains. Most areas are round or oblong and are 3 to 7 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 8 inches thick. The subsoil is about 32 inches thick. The upper part is yellowish brown, mottled, firm clay loam and sandy clay loam over a thin layer of sandy loam; the lower part is brown, firm silty clay. The substratum to a depth of about 64 inches is yellowish brown, brown, and dark grayish brown, firm silty clay and clay.

Included with this soil in mapping are small areas of very poorly drained Pewamo soils in drainageways.

The seasonal high water table is perched near the surface in winter and in spring and other extended wet periods. Permeability is moderate in the upper part of the subsoil and slow or very slow in the lower part and in the substratum. Runoff is slow. The root zone is mainly moderately deep to compact glacial till or lacustrine material. Available water capacity is moderate. Organic-matter content also is moderate. The surface layer can be easily tilled throughout a fairly wide range in moisture content. The upper part of the subsoil is slightly acid or medium acid, and the lower part ranges from slightly acid to moderately alkaline.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, and woodland. The potential for building site development, sanitary facilities, and most recreation uses is poor.

This soil is suited to corn, soybeans, wheat, oats, pasture, and hay. Cultivated crops can be grown frequently if optimum management is applied. The major limitation for farming is seasonal wetness. Surface drains remove excess surface water. A subsurface drainage system is commonly used to lower the perched water table. These drains are more effective if placed on or

above the slowly or very slowly permeable glacial till or lacustrine material. Managing crop residue or regularly adding other organic material and planting cover crops improve tilth and reduce surface crusting.

If this soil is pastured, overgrazing or grazing during wet periods, when the soil is soft and sticky, causes surface compaction and poor tilth. Pasture rotation and restricted grazing during wet periods keep the pasture and the soil in good condition.

Undrained areas are suited to woodland. Species that can tolerate some wetness should be selected for new plantings. The use of harvesting equipment is limited during wet periods. Reforestation with desirable species is difficult because of plant competition. This competition can be reduced by spraying, mowing, and disking.

The seasonal high water table, the slow or very slow permeability, a high shrink-swell potential, and low strength severely limit the use of this soil as a site for sanitary facilities and buildings. Drainage ditches and subsurface drains lower the seasonal high water table. Foundation drains and protective exterior wall coatings help to keep basements dry. Landscaping is needed on building sites to keep surface water away from foundations. Sanitary facilities should be connected to commercial sewers if possible.

Capability subclass IIw; woodland suitability subclass 2o.

**HdB—Haskins loam, 2 to 6 percent slopes.** This deep, gently sloping, somewhat poorly drained soil is on terraces and outwash plains. Most areas are long and narrow and are 5 to 15 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 9 inches thick. The subsoil is dark brown and yellowish brown, mottled, firm loam and gravelly clay loam about 25 inches thick. The substratum to a depth of about 60 inches is yellowish brown, firm silty clay.

Included with this soil in mapping are small areas of Homer soils on outwash plains and in melt water channels.

The seasonal high water table is perched near the surface in winter and in spring and other extended wet periods. Permeability is moderate in the subsoil and slow or very slow in the substratum. Runoff is medium. The root zone is mainly moderately deep to compact glacial till or lacustrine material. Available water capacity is moderate. Organic-matter content also is moderate. The surface layer can be easily tilled throughout a fairly wide range in moisture content. The upper part of the subsoil is slightly acid or medium acid, and the lower part ranges from slightly acid to moderately alkaline.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. The potential for building site development, sanitary facilities, and most recreation uses is poor.

This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Seasonal wetness and erosion are the main concerns of management. Most cropped areas are drained by a system of randomly spaced subsurface drains because the landscape is uneven. These drains are more effective if placed on or above the slowly or very slowly permeable glacial till or lacustrine material. Minimizing tillage, planting winter cover crops, and establishing grassed waterways help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, reduces crusting, and increases the rate of water infiltration.

The major concerns in managing pasture are overgrazing and grazing during wet periods, when the soil is soft and sticky. The soil compacts easily, the compaction resulting in poor tilth and retarded growth. Pasture rotation and restricted grazing during wet periods keep the pasture and the soil in good condition.

Undrained areas are suited to woodland. Species that can tolerate some wetness should be selected for new plantings. The use of harvesting equipment is limited during wet periods. Reforestation with desirable species is difficult because of plant competition. This competition can be reduced by spraying, mowing, or disking.

Seasonal wetness, slow or very slow permeability, low strength, and a high shrink-swell potential severely limit the use of this soil as a site for most sanitary facilities and for building site development. Drainage can be improved by installing surface and subsurface drains. Sanitary facilities should be connected to central sewers and treatment facilities if possible. Providing artificial drainage and suitable base material improves local roads by overcoming the risk of damage caused by frost action and low strength.

Capability subclass IIe; woodland suitability subclass 2o.

**HeA—Henshaw silt loam, 0 to 2 percent slopes.** This deep, nearly level, somewhat poorly drained soil is on terraces and in basins of former lakes. Most areas are irregularly shaped and are 5 to 20 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is about 41 inches thick. The upper part is light yellowish brown, grayish brown, and gray, mottled, friable silt loam and firm silty clay loam; the lower part is brown, light brownish gray, and yellowish brown, mottled, firm silty clay loam and silt loam. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm silt loam.

Included with this soil in mapping are small areas of Homer soils on terraces. Also included are areas where the surface layer and subsoil are limy.

The seasonal high water table is between depths of 1 foot and 2 feet in winter and in spring and other extended wet periods. Permeability is moderately slow. Runoff is slow. The root zone is deep and has a high

available water capacity. Organic-matter content is moderate. The surface layer crusts after heavy rains. The upper part of the subsoil ranges from strongly acid to neutral, and the lower part is slightly acid to mildly alkaline.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. The potential for building site development and sanitary facilities is poor.

Drained areas are well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Seasonal wetness is the main limitation on cropland. Unless drained, this soil warms slowly in spring and dries late in spring. Most cropped areas have been drained. A subsurface drainage system is commonly used to remove the excess water from the root zone. Surface drains are used in some areas. Returning crop residue to the soil or adding other organic material and planting cover crops improve tilth, reduce crusting, and help to control erosion.

This soil is poorly suited to grazing early in spring. After pasture is overgrazed or grazed during wet periods, when the soil is soft and sticky, tilth is poor because the silt loam surface layer compacts easily. Pasture rotation and restricted grazing during wet periods keep the pasture and the soil in good condition.

This soil is well suited to trees that are tolerant of some wetness. Competing vegetation can be controlled or removed by spraying, mowing, or disking. The use of planting and harvesting equipment is limited by wetness during winter and spring.

Seasonal wetness, moderately slow permeability, and low strength limit the use of this soil as a site for buildings and most sanitary facilities. Landscaping is needed on building sites to keep surface water away from foundations. Drainage can be improved by subsurface drains and open ditches. Foundations of dwellings and small buildings should be designed to prevent the structural damage caused by frost action. Excavations are limited by wetness during winter and spring. Sanitary facilities should be connected to central sewers and treatment facilities if possible. Providing artificial drainage and suitable base material improves local roads.

Capability subclass IIw; woodland suitability subclass 2o.

**HeB—Henshaw silt loam, 2 to 6 percent slopes.** This deep, gently sloping, somewhat poorly drained soil is on slightly convex knolls in basins of former lakes and on terraces. Most areas are irregularly shaped and range from 10 to 60 acres in size.

Typically, the surface layer is grayish brown, friable silt loam about 11 inches thick. The subsoil is yellowish brown, mottled, firm silty clay loam or silt loam about 25 inches thick. The substratum to a depth of about 60 inches is yellowish brown, calcareous, friable silt loam.

Included with this soil in mapping are small areas of Homer and Sleeth soils on terraces.

The seasonal high water table is between depths of 1 foot and 2 feet in winter and in spring and other extended wet periods. Permeability is moderately slow. Runoff is medium. The root zone is deep and has a high available water capacity. The surface layer crusts after heavy rains. Organic-matter content is moderate. The upper part of the subsoil is strongly acid to neutral, and the lower part is slightly acid to mildly alkaline.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. The potential for building site development and sanitary facilities is poor.

This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Seasonal wetness and erosion are the main limitations on cropland. Most cropped areas are drained by randomly spaced surface drains. Minimizing tillage, planting cover crops, and establishing grassed waterways reduce the risk of erosion. Returning crop residue to the soil or regularly adding other organic material reduces crusting, increases the water intake rate, and decreases the runoff rate.

The major concerns in managing pasture are overgrazing and grazing during wet periods, when the soil is soft and sticky. This soil compacts easily, the compaction resulting in poor tilth, increased runoff, and damage to pastures that are grazed when wet or are overgrazed. Pasture rotation and restricted grazing during wet periods keep the pasture and the soil in good condition.

Undrained areas are suited to woodland. Species tolerant of some wetness should be selected for planting. The use of harvesting equipment is limited during wet periods. Reforestation with desirable species is difficult because of plant competition.

Seasonal wetness, moderately slow permeability, and low strength limit the use of this soil as a site for buildings and most sanitary facilities. Foundations should be designed to prevent the structural damage caused by frost action. Excavation is limited by wetness during winter and spring. Providing artificial drainage and suitable base material improves local roads. Sanitary facilities should be connected to central sewers and treatment facilities if possible.

Capability subclass IIe; woodland suitability subclass 2o.

**HoA—Homer silt loam, 0 to 2 percent slopes.** This deep, nearly level, somewhat poorly drained soil occurs as irregularly shaped areas on low rises and long and narrow strips on terraces and outwash plains. Most areas are 5 to 20 acres in size.

Typically, the surface layer is dark brown, friable silt loam about 11 inches thick. The subsoil is about 28 inches thick. The upper part is brown and yellowish brown, mottled, friable silt loam and firm silty clay loam

and clay loam; the lower part is gray, dark gray, and pale brown, firm clay, gravelly clay loam, and gravelly loam. The lower part is mottled to a depth of about 33 inches. The substratum to a depth of about 60 inches is brown and light brownish gray, loose gravelly sand.

The seasonal high water table is between depths of 1 foot and 3 feet in winter, early in spring, and in other extended wet periods. Permeability is moderate in the subsoil and very rapid in the substratum. Runoff is slow. The root zone is mainly moderately deep to sand and gravel and has a moderate available water capacity. Organic-matter content is moderate. The surface layer can be easily tilled throughout a fairly wide range in moisture content. The upper part of the subsoil is slightly acid or neutral, and the lower part is mildly alkaline.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. The potential for building site development and sanitary facilities is poor.

This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Seasonal wetness is the main limitation. Unless drained, the soil warms slowly in spring and dries late in spring. Most cropped areas have been drained. A subsurface drainage system is the most common drainage method. Returning crop residue to the soil or adding other organic material maintains good tilth and reduces surface crusting. The soil should be tilled and crops harvested at optimum moisture levels and with the kind of equipment that minimizes compaction.

Overgrazing or grazing during wet periods, when the soil is soft and sticky, causes compaction and poor tilth. Pasture rotation and restricted grazing during wet periods keep the pasture and the soil in good condition.

This soil is suited to trees and other vegetation grown as habitat for wildlife. Species that can tolerate some wetness should be selected for new plantings. Seedlings grow well if competing vegetation is controlled by spraying, mowing, or disking.

Seasonal wetness and seepage severely limit the use of this soil as a site for buildings and most sanitary facilities. The wetness also limits recreation uses. The seepage can result in pollution of underground water supplies. Sanitary facilities should be connected to central sewers if possible. Drainage ditches and subsurface drains can lower the water table in areas where good outlets are available. Landscaping is needed on building sites to keep surface water away from foundations. Foundation drains and protective exterior wall coatings help to keep basements dry. Excavation is limited during winter and spring because the water table is high and banks can slough.

Capability subclass IIw; woodland suitability subclass 3o.

**HoB—Homer silt loam, 2 to 6 percent slopes.** This deep, gently sloping, somewhat poorly drained soil occurs as irregularly shaped areas on low knolls and long and narrow strips on outwash plains and terraces. Most areas are 5 to 20 acres in size.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is about 29 inches thick. The upper part is dark brown, mottled, firm silty clay loam; the lower part is yellowish brown and dark yellowish brown, mottled, firm clay loam and gravelly sandy loam. The substratum to a depth of about 60 inches is pale brown, loose gravelly sand.

Included with this soil in mapping are small areas of Eldean soils on knolls and Lippincott soils in shallow depressions and drainageways.

The seasonal high water table is between depths of 1 foot and 3 feet in winter, early in spring, and in other extended wet periods. Permeability is moderate in the subsoil and very rapid in the substratum. Runoff is medium. The root zone is mainly moderately deep to sand and gravel and has a moderate available water capacity. Organic-matter content is moderate. The surface layer can be easily tilled throughout a fairly wide range in moisture content. The upper part of the subsoil is slightly acid or neutral, and the lower part is mildly alkaline.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. The potential for building site development and sanitary facilities is poor.

This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Controlling erosion and reducing wetness are the main management concerns. Most cropped areas are drained by a system of randomly spaced subsurface drains. Minimizing tillage, planting cover crops, and establishing grassed waterways reduce the risk of erosion. Returning crop residue to the soil or regularly adding other organic material improves fertility, reduces crusting, and increases the rate of water intake.

The major concerns in managing pasture are overgrazing and grazing during wet periods, when the soil is soft and sticky. If the pasture is grazed when wet or is overgrazed, the soil compacts easily, the compaction resulting in poor tilth and increased runoff. Pasture rotation and restricted grazing during wet periods keep the pasture and the soil in good condition.

Undrained areas are suited to woodland. Species that can tolerate some wetness should be selected for new plantings. Reforestation with desirable species is difficult because of plant competition. Tree seedlings grow well if competing vegetation is controlled or removed by spraying, mowing, and disking.

Seasonal wetness and seepage severely limit this soil as a site for buildings and sanitary facilities. The seepage can result in pollution of the underground water supplies. Sanitary facilities should be connected to central sewers if possible. Drainage ditches and subsurface drains can lower the seasonal high water table. Lands-

caping is needed on building sites to keep surface water away from foundations. Providing artificial drainage and suitable base material improves local roads. Excavation is limited during winter and spring because the water table is high and banks can slough.

Capability subclass IIe; woodland suitability subclass 3o.

**La—Latty silty clay.** This deep, nearly level, very poorly drained soil is on smooth flats and in shallow depressions on lake plains. In the lower parts of depressions, it can be ponded by runoff from adjacent higher lying soils. Slope is 0 to 2 percent. Most areas are irregularly shaped and range from 20 to more than 1,000 acres in size.

Typically, the surface layer is dark grayish brown, firm silty clay about 8 inches thick. The subsoil is mottled, firm silty clay about 36 inches thick. The upper part is dark gray and olive gray; the lower part is gray and dark yellowish brown. The substratum to a depth of about 60 inches is yellowish brown or dark yellowish brown, calcareous, firm silty clay and clay.

Included with this soil in mapping are small areas of Fulton and Henshaw soils on slight rises.

The seasonal high water table is near the surface briefly in winter and in spring and other extended wet periods. This soil dries slowly in spring. Permeability is slow. Runoff is very slow or ponded. In drained areas the root zone is deep and has a moderate available water capacity. Organic-matter content is moderate. The soil is sticky when wet and puddles and clods easily. The upper part of the subsoil is neutral or slightly acid, and the lower part is neutral or mildly alkaline.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, and woodland. The potential for building site development, sanitary facilities, and recreation uses is poor.

The excessive wetness, the clayey surface layer, and the very slow permeability are the major limitations for farming. Undrained areas are too wet for cultivated crops. Drained areas are suited to corn and soybeans. A combination of surface and subsurface drainage is commonly used to improve drainage. Surface crusting, compaction, and clodding can occur unless the soil is tilled and crops are harvested at optimum moisture levels. Returning crop residue to the soil and planting cover crops improve organic-matter content and tilth and increase the rate of water intake.

Drained areas are suited to pasture or hay. Surface compaction, poor tilth, and a decreased infiltration rate result from grazing during wet periods, when the soil is soft and sticky. Selection of grasses and legumes that are tolerant of wetness, pasture rotation, and timely deferment of grazing improve the pasture.

This soil is suitable as woodland and as habitat for wetland wildlife. Reforestation with desirable species is difficult because of a high seedling mortality rate and severe plant competition. Seedlings survive and grow well if competing vegetation is controlled or removed by spraying, mowing, or disking. The use of harvesting equipment is limited during wet periods.

This soil is severely limited as a site for most buildings and sanitary facilities because of the seasonal wetness, the very slow permeability, a high shrink-swell potential, and the clayey surface layer. Providing artificial drainage and suitable base material improves local roads. Extensive drainage is needed in intensively used recreation areas.

Capability subclass IIIw; woodland suitability subclass 3w.

**Lb—Latty silty clay, occasionally flooded.** This deep, nearly level, very poorly drained soil is on flood plains. It is subject to occasional flooding. Slope is 0 to 2 percent. Most areas are long and narrow and range from 30 to 80 acres in size.

Typically, the surface layer is dark grayish brown, firm silty clay about 14 inches thick. The subsoil is dark gray, mottled, firm silty clay about 36 inches thick. The substratum to a depth of about 60 inches is dark brown, mottled, firm clay loam.

The seasonal high water table is near the surface briefly in winter and in spring and other extended wet periods. This soil dries slowly in spring. Permeability is very slow. Runoff also is very slow. In drained areas the root zone is deep and has a moderate available water capacity. Organic-matter content is moderate. The soil is sticky when wet and puddles and clods easily. The upper part of the subsoil is neutral or slightly acid, and the lower part is neutral or mildly alkaline.

Most of the acreage is cropland or woodland. The wooded areas are undrained. This soil has good potential for cultivated crops, hay, pasture, and woodland. The potential for building site development, sanitary facilities, and recreation uses is poor.

The seasonal wetness, the clayey texture, and the flooding are the major limitations on cropland. Flooding commonly occurs late in winter and early in spring. Drained areas are suited to corn and soybeans. Flooding often damages winter grain unless the crop is protected from floodwater. A combination of surface and subsurface drains is commonly used to improve drainage. Draining the soil is difficult in a few areas because adequate outlets are not available. Maintaining good tilth is an important concern. The soil commonly is worked during wet periods, when it is soft and sticky. As a result, it puddles and clods.

The main concerns in managing pasture are overgrazing and grazing during wet periods, when the soil is soft and sticky. The surface layer compacts easily, the compaction resulting in poor tilth. Pasture rotation and restricted grazing during wet periods keep the pasture and the soil in good condition.

This soil is suited to trees that are tolerant of wetness. Tree seedlings grow well if competing vegetation is controlled or removed by spraying, mowing, or disking. The use of planting and harvesting equipment is limited by wetness in winter and spring.

This soil is severely limited as a site for most buildings, sanitary facilities, and recreation uses because of the seasonal wetness, the flooding, the very slow permeability, the clayey surface layer, and a high shrink-swell potential. Diking to control flooding is difficult.

Capability subclass IIIw; woodland suitability subclass 3w.

**Ln—Linwood muck.** This deep, nearly level, very poorly drained soil is in depressions in till plains, outwash plains, and lake plains. It is subject to frequent flooding. Slope is 0 to 2 percent. Most areas are circular and range from 5 to 40 acres in size.

Typically, the surface layer is very dark brown, friable muck about 5 inches thick. Below this, to a depth of about 43 inches, is very dark brown and black, friable and firm muck. The substratum to a depth of about 60 inches is gray, firm silt loam.

Included with this soil in mapping are small areas of Carlisle soils.

Water is near the surface and ponds for long periods. Runoff is very slow. Permeability is moderate. The root zone is deep and has a very high available water capacity. Organic-matter content is very high. Tilth is good. The muck ranges from strongly acid to mildly alkaline.

Most of the acreage is cropland. This soil has good potential as cropland and pasture and as habitat for wetland wildlife. The potential for building site development, sanitary facilities, and recreation uses is poor.

The very poor natural drainage and the flooding are the major limitations of this soil for cultivated crops. Drained areas are used mainly for corn. Surface drains commonly remove ponded water. Subsurface drains are also used, but draining some areas is difficult because adequate outlets are not available. Subsidence or shrinkage occurs as a result of the oxidation of the organic material after the soil is drained. Controlled drainage in areas where the water table can be raised or lowered reduces the amount of shrinkage. During dry periods soil blowing and the risk of fire are the major concerns. The risk of soil blowing can be reduced by irrigation, windbreaks, and cover crops.

Drained areas are suited to the grasses commonly grown for hay or pasture. Water-tolerant grasses, such as reed canarygrass, grow well. Overgrazing or grazing during wet periods, when the soil is soft and sticky, damages plants.

This soil is not well suited to woodland because it is wet and unstable. Undrained areas support water-tolerant trees and some cattails, reeds, and sedges. Establishing seedlings is difficult, and the larger trees are subject to windthrow. The wetness seriously limits the use of logging equipment.

This soil is seriously limited as a site for buildings, sanitary facilities, and recreation uses by wetness, flooding, low strength, and seepage. Undrained areas provide good habitat for ducks, muskrat, and other wetland wildlife.

Capability subclass IIw; woodland suitability subclass 4w.

**Lp—Lippincott silty clay loam.** This deep, nearly level, very poorly drained soil is in low lying areas on outwash plains, terraces, and valley trains. In the lower parts of depressions, it can be ponded by runoff from adjacent higher lying soils. Slope is 0 to 2 percent. Most areas are long and narrow and range from 10 to 200 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 12 inches thick. The subsoil is about 15 inches thick. The upper part is dark gray and gray, mottled, firm clay; the lower part is gray, very friable very gravelly loam. The substratum to a depth of about 60 inches is light brownish gray, loose very gravelly sand.

Included with this soil in mapping are small areas of Homer soils on slight rises.

The seasonal high water table is at the surface in fall and winter and in spring and other extended wet periods. Permeability is moderate in the subsoil and rapid in the substratum. Runoff is very slow or ponded. The root zone is deep and has a low or moderate available water capacity. Tilth is fair to good. Organic-matter content is high. The upper part of the subsoil is slightly acid or neutral, and the lower part is mildly alkaline.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. The potential for building site development, sanitary facilities, and recreation uses is poor.

If artificially drained, this soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Row crops can be grown year after year if optimum management is applied. Most cropped areas have been drained. Seasonal wetness is the main limitation on cropland. Subsurface drains and open ditches provide drainage. Timely tillage is important because the soil puddles and clods if it is worked during wet periods, when it is soft and sticky. Returning crop residue to the soil and planting cover crops reduce crusting, improve tilth, and increase the rate of water infiltration.

If this soil is used for pasture, controlled grazing is needed, even in drained areas. If the pasture is grazed during wet periods, when the soil is soft and sticky, the surface layer compacts easily. The compaction results in poor tilth. Pasture rotation and restricted grazing during wet periods keep the pasture and the soil in good condition.

This soil is suited to trees that are tolerant of wetness. A few areas support native hardwoods. Tree seedlings can survive and grow well only if competing vegetation is controlled. Competing vegetation can be controlled or removed by spraying, mowing, or disking. Wetness severely limits the use of planting and harvesting equipment in winter and spring.

Seasonal wetness, ponding, and seepage severely limit the use of this soil as a site for buildings and most sanitary facilities. The wetness also limits recreation uses. Ditches are somewhat effective in controlling the water if outlets are available. Excavations are limited in winter and spring because the water table is high and banks can slough. As a result of seepage, the effluent from sanitary facilities can pollute underground water supplies. Sanitary facilities should be connected to commercial sewers if possible. Providing artificial drainage and suitable base material improves local roads.

Capability subclass IIw; woodland suitability subclass 2w.

**Ls—Lippincott-Urban land complex.** This map unit consists of a nearly level, very poorly drained Lippincott silty clay loam and Urban land. It occurs as a large low lying area on terraces. The Lippincott soil makes up 50 to 65 percent of the unit and Urban land 20 to 35 percent. The Lippincott soil and Urban land are so intricately mixed that mapping them separately is not practical. Slope is 0 to 2 percent.

Typically, the Lippincott soil has a surface layer of very dark gray, friable silty clay loam about 12 inches thick. The subsoil is about 20 inches thick. The upper part is gray, mottled, firm clay; the lower part is gray, friable gravelly loam. The substratum to a depth of about 60 inches is light brownish gray, loose very gravelly sand. In places the soil has been radically altered. Some of the low areas have been filled or leveled during construction, and other small areas have been cut, built up, or smoothed.

The Urban land part of the unit is covered by streets, parking lots, buildings, and other structures that so obscure or alter the soils that identification is not feasible.

Included with this unit in mapping are small areas of Homer soils on slight rises.

Some of the acreage is artificially drained through sewer systems, gutters, subsurface drains, and, to a lesser extent, surface ditches. Unless drained, the Lippincott soil has a water table near the surface during wet periods and in some low positions is ponded by runoff from higher adjacent areas. Permeability is moderate in the subsoil and rapid in the substratum. Organic-matter content is high. The root zone is deep and has a low or moderate available water capacity. The upper part of the subsoil is slightly acid or neutral, and the lower part is mildly alkaline. The shrink-swell potential is moderate throughout most of the subsoil and in the substratum.

The Lippincott soil, or open part of the map unit, is used for parks, building sites, lawns, and gardens. It has fair potential for lawns, vegetable and flower gardens, trees, and shrubs. It has poor potential for recreation uses, building site development, and sanitary facilities.

The Lippincott soil is suited to grasses, flowers, vegetables, trees, and shrubs if excess water is removed. Several methods of artificial drainage can be successful on this soil. Onsite investigation is needed to determine the best method for a particular area. Perennial plants selected for planting should have a fairly high tolerance for wetness. Erosion generally is not a major problem unless the soil is disturbed and exposed for a considerable period or is used as a watercourse. The spots of cut and fill land generally are not well suited to lawns and gardens. Tilth is very poor in exposed subsoil material, which is sticky when wet and hard when dry.

Limitations are severe if the Lippincott soil is used as a site for buildings and recreation areas. Artificial drainage is needed. Dwellings and small buildings should be constructed without basements. Sanitary facilities should be connected to commercial sewers and treatment facilities. Replacing or covering the upper layers of the soil with suitable base material minimizes maintenance of local roads and streets.

Lippincott soil in capability subclass IIw, woodland suitability subclass 2w; Urban land not assigned to a capability subclass or a woodland suitability subclass.

**Ma—Martisco mucky silt loam.** This deep, nearly level, very poorly drained soil is in low lying areas in basins of former glacial lakes. It is subject to frequent flooding. Slope is 0 to 2 percent. Most areas are irregularly shaped and range from 10 to 150 acres in size.

Typically, the surface layer is very dark brown, friable mucky silt loam about 10 inches thick. The subsurface layer is very dark gray, friable silt loam about 6 inches thick. The substratum to a depth of about 60 inches is gray, mottled, firm silt loam over light gray, mottled, firm and friable marl.

Included with this soil in mapping are small areas of Edwards soils. These soils have a thick organic deposit overlying the marl.

Water is near the surface and ponds for long or very long periods. Runoff is very slow. Permeability is moderate or moderately rapid in the surface layer and subsoil and slow in the marl. The root zone is mainly shallow to marl and has a low available water capacity. It is mildly alkaline or moderately alkaline. Organic-matter content is very high. Tilth is good.

Most of the acreage is cropland or pasture. This soil has fair potential for cropland and pasture. It has good potential as habitat for wetland wildlife and poor potential as a building site, as a site for sanitary facilities, and as woodland.

The very poor natural drainage, the flooding, and the marl close to the surface are the major limitations if this

soil is farmed. If adequately drained, the soil can be used for corn and soybeans. Subsurface drains and open ditches provide drainage. Draining some areas is difficult because adequate outlets are not available. The alkalinity of the soil reduces the effectiveness of fertilizers. Acid-base fertilizers help to solve this problem.

Water-tolerant grasses should be selected for hay and pasture. Overgrazing or grazing during wet periods, when the soil is soft and sticky, damages the pasture and compacts the soil.

This soil generally is not suited to woodland unless it is drained. Undrained areas support some water-tolerant trees and cattails, reeds, and sedges.

The use of this soil as a site for buildings, sanitary facilities, and recreation areas is severely limited by flooding, wetness, and poor stability. Undrained areas provide good habitat for ducks, muskrat, and other wetland wildlife.

Capability subclass IVw; woodland suitability subclass 5w.

**Mc—Martisco Variant silt loam.** This deep, nearly level, very poorly drained soil is in depressions in lake plains. It is subject to frequent flooding. Slope is 0 to 2 percent. Most areas are irregularly shaped and range from 20 to 60 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The substratum to a depth of about 60 inches is gray, light gray, and white, friable silty marl.

Water is near the surface and ponds for long periods. Runoff is very slow. Permeability is moderate in the surface layer. The root zone is very shallow to marl and has a very low available water capacity. It is moderately alkaline. Organic-matter content is high.

This soil is commonly used as cropland or pasture. It has poor potential for most uses. It is best suited as habitat for wetland wildlife.

The very poor natural drainage, the flooding, and the shallowness to marl are the major limitations if this soil is farmed. If adequately drained, the soil can be used for corn and soybeans. Subsurface drains and open ditches provide drainage. Draining some areas is difficult because adequate outlets are not available. The alkalinity of the soil reduces the effectiveness of fertilizers. Acid-base fertilizers help to solve this problem.

Water-tolerant grasses should be selected for hay and pasture. Overgrazing or grazing during wet periods, when the soil is soft and sticky, damages the pasture and compacts the soil.

This soil generally is not suited to woodland unless it is drained. Undrained areas support some water-tolerant trees and cattails, reeds, and sedges.

The use of this soil as a site for buildings, sanitary facilities, and recreation areas is severely limited by flooding, wetness, and poor stability. The soil does not have the strength and stability needed to support vehicular traffic during most of the year. Undrained areas provide habitat for wetland wildlife.

Capability subclass IVw; not assigned to a woodland suitability subclass.

**MhB—Miamian silt loam, 2 to 6 percent slopes.** This deep, gently sloping, well drained soil is on knolls and short, uneven side slopes. Most areas are irregularly shaped and range from 40 to 70 acres in size.

Typically, the surface layer is dark brown, friable silt loam about 6 inches thick. The subsoil is about 21 inches thick. The upper part is dark yellowish brown, firm clay loam and clay; the lower part is yellowish brown, firm loam. The substratum to a depth of about 60 inches is yellowish brown, calcareous, firm loam.

Included with this soil in mapping are narrow strips of Crosby soils on the lower part of slopes and in drainageways.

Permeability is moderately slow. Runoff is medium. The root zone is mainly moderately deep to compact glacial till. Available water capacity is moderate. Organic-matter content also is moderate. Tilth is good. The upper part of the subsoil ranges from strongly acid to neutral and the lower part from slightly acid to mildly alkaline.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. The potential is good for building site development and fair or good for sanitary facilities.

This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If the soil is cultivated, erosion is a hazard. The surface layer crusts after hard rains. Minimizing tillage, planting cover crops, incorporating crop residue into the soil, and establishing waterways increase the rate of water infiltration and reduce crusting and the risk of erosion. A few areas that have long, smooth slopes can be farmed on the contour.

The use of the soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing during wet periods, when the soil is soft and sticky, causes surface compaction, excessive runoff, and poor tilth. Pasture rotation and restricted use during wet periods keep the pasture and the soil in good condition.

This soil is well suited to trees. A few small areas support native hardwoods. Plant competition can be reduced by spraying, mowing, or disking.

This soil is suited as a site for buildings and some sanitary facilities if proper design and installation procedures are used. It does not have the strength and stability needed to support heavy vehicular traffic, especially during wet periods. Local roads can be improved by providing suitable base material. The moderately slow permeability limits the soil as a septic tank absorption field. It can be partly overcome by increasing the size of the absorption area. Some areas are good sites for ponds.

Capability subclass IIe; woodland suitability subclass 1o.

**MhC2—Miamian silt loam, 6 to 12 percent slopes, moderately eroded.** This deep, sloping, well drained soil is on knolls, ridges, and side slopes at the head of drainageways. Most areas are irregularly shaped and range from 5 to 50 acres in size.

Typically, the surface layer is brown, friable silt loam about 6 inches thick. The subsoil is about 18 inches thick. The upper part is dark yellowish brown, firm clay; the lower part is yellowish brown, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown, calcareous, firm loam.

Included with this soil in mapping are narrow strips of Crosby soils on the lower part of slopes and in drainageways. Also included are small areas on the upper part of slopes where the surface layer is dark yellowish brown silty clay loam.

Permeability is moderately slow. Runoff is rapid. The root zone is mainly moderately deep to compact glacial till. Available water capacity is moderate. Organic-matter content is moderately low. Tilth is good. The upper part of the subsoil ranges from strongly acid to neutral and the lower part from slightly acid to mildly alkaline.

Most of the acreage is cropland or pasture. This soil has fair potential for cropland and good potential for pasture and trees. The potential is fair for building site development and most sanitary facilities.

This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. The erosion hazard is severe in cultivated areas. Including grasses and legumes in the cropping system helps to control erosion and maintains tilth in cultivated areas. The surface layer crusts after hard rains. After it is plowed when wet and sticky, the soil is cloddy. Minimizing tillage, planting cover crops, incorporating crop residue into the soil, and tilling at proper moisture levels increase the rate of water infiltration and reduce crusting and the risk of erosion. Grassed waterways are beneficial. Some areas that have long, smooth slopes can be farmed on the contour.

The use of this soil for pasture is effective in controlling erosion. Overgrazing or grazing during wet periods, when the soil is soft and sticky, causes surface compaction, excessive runoff, and poor tilth. Pasture rotation and restricted use during wet periods keep the pasture and the soil in good condition.

This soil is suited to trees. Plant competition can be reduced by spraying, mowing, or disking. Protection against erosion is needed on logging roads.

This soil is suited as a site for buildings and most sanitary facilities if proper design and installation procedures are used. Slope, moderately slow permeability, a moderate shrink-swell potential, and low strength are the main limitations. Septic tank absorption fields can be improved by increasing the size of the absorption area. Providing suitable base material improves local roads. This soil is suitable for pond embankments.

Capability subclass IIIe; woodland suitability subclass 1o.

**MhD2—Miamian silt loam, 12 to 18 percent slopes, moderately eroded.** This deep, moderately steep, well drained soil is on convex ridgetops and side slopes along drainageways. Most areas are irregularly shaped and range from 5 to 30 acres in size.

Typically, the surface layer is brown, friable silt loam about 5 inches thick. The subsoil is dark yellowish brown, firm clay about 15 inches thick. The substratum to a depth of about 60 inches is yellowish brown, calcareous, firm loam.

Included with this soil in mapping are small areas on the upper part of slopes where the surface layer is dark yellowish brown clay loam.

Permeability is moderately slow. Available water capacity is moderate. Runoff is very rapid. The soil is droughty during extended dry periods because water is lost as runoff. The root zone is mainly moderately deep to compact glacial till. Organic-matter content is moderately low. Tilth is good. The upper part of the subsoil ranges from strongly acid to neutral and the lower part from slightly acid to mildly alkaline.

Most of the acreage is cropland and pasture. A few areas are woodland. This soil has fair potential for pasture and good potential for woodland. It has poor potential for cultivated crops, building site development, and sanitary facilities.

The slope limits the use of this soil as cropland. If the soil is cultivated, the hazard of erosion is severe. Row crops can be grown occasionally if erosion is controlled and the soil is otherwise well managed. The slope causes some problems in the use of machinery and in the installation of erosion-control measures. After it is plowed when sticky and wet, the soil is cloddy. It puddles and crusts easily. Minimizing tillage, planting cover crops, returning crop residue to the soil, and tilling and harvesting at proper moisture levels help to control erosion, increase the rate of water infiltration, and reduce surface crusting. Grassed waterways are beneficial.

The use of this soil for pasture is effective in controlling erosion. Overgrazing or grazing during wet periods, when the soil is soft and sticky, causes surface compaction, excessive runoff, and poor tilth. Pasture rotation and restricted use during wet periods keep the pasture and the soil in good condition. The pasture can be reseeded with cover crops or companion crops or by trash-mulch or no-till seeding methods.

This soil is suited to trees. Plant competition can be reduced by spraying, mowing, or disking. The slope moderately limits the use of equipment. Logging roads and skid trails should be protected against erosion and established across the slope if possible. This soil has good potential as habitat for woodland wildlife.

The slope and the moderately slow permeability severely limit this soil as a site for most buildings and sanitary facilities. If proper design and installation procedures are used, the slope can be partly overcome. Maintaining as much plant cover as possible on the site during construction reduces the erosion hazard. Trails in recreation areas should be protected against erosion and laid out on the contour if possible.

Capability subclass IVe; woodland suitability subclass 1r.

**MhE2—Miamian silt loam, 18 to 25 percent slopes, moderately eroded.** This deep, steep, well drained soil is along drainageways and on convex ridgetops. Most areas are long and narrow and range from 5 to 30 acres in size.

Typically, the surface layer is brown, friable silt loam about 4 inches thick. The subsoil is about 16 inches thick. The upper part is dark yellowish brown, firm clay; the lower part is yellowish brown, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown, calcareous, firm loam.

Included with this soil in mapping are areas on the upper part of slopes where the surface layer is yellowish brown clay loam.

Permeability is moderately slow. Available water capacity is moderate. Runoff is very rapid. The soil is droughty during extended dry periods because water is lost as runoff. The root zone is mainly moderately deep to compact glacial till. Organic-matter content is low. Tilth is good. The upper part of the subsoil ranges from strongly acid to neutral and the lower part from slightly acid to mildly alkaline.

Most of the acreage is pasture or woodland. This soil has fair potential for pasture and good potential for woodland and as habitat for woodland wildlife. It has poor potential for cropland, building site development, sanitary facilities, and recreation uses.

This soil is too steep for cultivated crops but can be used for permanent pasture of grasses and legumes. Erosion is a serious hazard unless adequate plant cover is maintained. It is also a serious hazard when pastures are reseeded. Trash-mulch or no-till seeding methods reduce the risk of erosion. Pasture rotation and restricted use during wet periods keep the pasture and the soil in good condition.

Sizable areas support native hardwoods. This soil is well suited to trees. The slope moderately limits the use of equipment. Competing vegetation can be controlled by spraying, mowing, or disking. Logging roads and skid trails should be constructed on the contour and protected against erosion.

This soil is severely limited as a site for most buildings and sanitary facilities because of the slope and the moderately slow permeability. As much plant cover as possible is needed during construction. Trails in recreation areas should be protected against erosion and laid out on the contour if possible.

Capability subclass VIe; woodland suitability subclass 1r.

**MhF—Miamian silt loam, 25 to 50 percent slopes.** This deep, very steep, well drained soil is along drainageways. Most areas are long and narrow and range from 15 to 80 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 4 inches thick. The subsoil is dark yellowish brown, firm clay about 16 inches thick. The substratum to a depth of about 60 inches is yellowish brown, calcareous, firm loam.

Included with this soil in mapping are areas where the surface layer is dark yellowish brown clay loam.

Permeability is moderately slow. Available water capacity is moderate. Runoff is very rapid. The soil is droughty during extended dry periods because water is lost as runoff. The root zone is mainly moderately deep to compact glacial till. Organic-matter content is low. The upper part of the subsoil ranges from strongly acid to neutral and the lower part from slightly acid to mildly alkaline.

Most of the acreage is woodland. A few areas are pastured. This soil has poor potential for most uses because it is very steep. It has better potential as woodland, as habitat for woodland wildlife, and as a site for some recreation uses.

This soil is too steep for cultivated crops or hay and is limited as permanent pasture. The hazard of erosion is very severe if the plant cover is removed.

This soil is suited to trees. Most areas support native hardwoods. The slope severely limits the use of planting and logging equipment. Logging roads and skid trails should be protected against erosion and established across the slope if possible. Plant competition can be reduced by spraying and cutting.

Capability subclass VIIe; woodland suitability subclass 1r.

**MlB—Miamian-Urban land complex, undulating.** This map unit consists of Urban land and a deep, well drained Miamian soil on knolls and short, uneven side slopes in the uplands. Slopes range from 1 to 8 percent. Areas generally range from 40 to 300 acres in size. They are about 50 to 65 percent Miamian silt loam and 20 to 35 percent Urban land. The Miamian soil and the Urban land are so intricately mixed or are in such small areas that mapping them separately is not practical.

Typically, the Miamian soil has a brown, friable silt loam surface layer about 6 inches thick. The subsoil is about 21 inches thick. The upper part is dark yellowish brown, firm clay loam and clay; the lower part is yellowish brown, firm loam. The substratum to a depth of about 60 inches is yellowish brown, calcareous, firm loam. In

places the soil has been radically altered. Some small areas have been cut, built up, or smoothed.

The Urban land part of the unit is covered with streets, parking lots, buildings, and other structures that so obscure or alter the soil that identification is not feasible.

About 10 to 15 percent of this unit is included small areas of Celina soils on the less sloping parts of the landscape. These soils stay wet later in spring than the Miamian soil. Also included in mapping are some areas where limestone bedrock is at a depth of 40 to 60 inches.

Permeability is moderately slow in the Miamian soil. Runoff is medium or slow. The root zone is mainly moderately deep to compact glacial till. Available water capacity is moderate. Organic-matter content also is moderate. Tilth is good. The upper part of the subsoil ranges from strongly acid to neutral and the lower part from slightly acid to mildly alkaline. The shrink-swell potential is moderate.

The Miamian soil, or open part of the map unit, is used for parks, building sites, lawns, and gardens. It has good potential for lawns, vegetable and flower gardens, and trees and shrubs and as a site for most buildings and recreation uses.

The Miamian soil is well suited to grasses, flowers, vegetables, and trees and shrubs. Erosion is a hazard if the soil is disturbed or the surface is bare. The surface layer crusts after hard rains. Regular additions of organic material increase the rate of water infiltration and reduce crusting and the risk of erosion. The spots of cut and fill are not well suited to lawns and gardens. Tilth is very poor in exposed subsoil material, which is sticky when wet and hard when dry.

The Miamian soil is suited as a site for buildings and some sanitary facilities if proper design and installation procedures are used. Providing suitable base material improves local roads. Sanitary facilities should be connected to central sewers and treatment facilities if possible. The foundations and footings of dwellings and small buildings should be designed to prevent the structural damage caused by the moderate strength and the shrinking and swelling.

Miamian soil in capability subclass IIe, woodland suitability subclass 1o; Urban land not assigned to a capability subclass or woodland suitability subclass.

**MIC—Miamian-Urban land complex, rolling.** This map unit consists of Urban land and a deep, well drained Miamian soil on knolls, ridges, and side slopes in the uplands. Slopes range from 5 to 16 percent. Areas generally are 80 to 300 acres in size. They are 50 to 65 percent Miamian silt loam and 20 to 35 percent Urban land. The Miamian soil and the Urban land are so intricately mixed or are in such small areas that mapping them separately is not practical.

Typically, the Miamian soil has a brown, friable silt loam surface layer about 6 inches thick. The subsoil is about 18 inches thick. The upper part is dark yellowish brown, firm clay; the lower part is yellowish brown, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown, calcareous, firm loam. In places the soil has been radically altered. Some small areas have been cut, built up, or smoothed.

The Urban land part of the unit is covered with streets, parking lots, buildings, and other structures that so obscure or alter the soil that identification is not feasible.

Included with this soil in mapping are narrow strips of Celina soils on the lower part of slopes. These soils stay wet later in spring than the Miamian soil.

Permeability is moderately slow in the Miamian soil. Runoff is medium or rapid. The root zone is mainly moderately deep to compact glacial till. Available water capacity is moderate. Organic-matter content also is moderate. Tilth is good. The upper part of the subsoil ranges from strongly acid to neutral and the lower part from slightly acid to mildly alkaline.

The Miamian soil, or open part of the map unit, is used for parks, building sites, lawns, and gardens. It has good potential for lawns, vegetable and flower gardens, trees and shrubs, and building site development and fair potential for most sanitary facilities and recreation uses.

The Miamian soil is well suited to grasses, flowers, vegetables, and trees and shrubs. Erosion is a hazard if the soil is disturbed or the surface is bare. The surface layer crusts after hard rains. Regular additions of organic material increase the rate of water infiltration and reduce crusting and the risk of erosion. The spots of cut and fill are not well suited to lawns and gardens. Tilth is poor in exposed subsoil material, which is sticky when wet and hard when dry.

The Miamian soil is suited as a site for buildings and most sanitary facilities if proper design and installation procedures are used. The slope, the moderately slow permeability, a moderate shrink-swell potential, and moderate strength are the main limitations. Foundations and footings of dwellings and small buildings should be designed to prevent the structural damage caused by the moderate strength and the shrinking and swelling. Providing suitable base material improves local roads. Sanitary facilities should be connected to central sewers and treatment facilities if possible. As much plant cover as possible is needed during construction to reduce the risk of erosion.

Miamian soil in capability subclass IIIe, woodland suitability subclass 1o; Urban land not assigned to a capability subclass or woodland suitability subclass.

**MmC2—Miamian Variant silt loam, 6 to 15 percent slopes, moderately eroded.** This moderately deep, sloping, well drained soil is along drainageways. Most areas are long and narrow and range from 5 to 30 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is dark

brown and dark yellowish brown, firm clay about 15 inches thick. The substratum is yellowish brown, firm gravelly loam over shale bedrock, which is at a depth of about 35 inches.

Included with this soil in mapping are narrow strips of other Miamian soils on the lower part of slopes.

Permeability is moderately slow. Runoff is rapid. The root zone is moderately deep to shale bedrock. Available water capacity is low. Organic-matter content is moderately low. Tilth is good. The upper part of the subsoil is slightly acid or neutral, and the lower part is slightly acid to mildly alkaline.

This soil is used as cropland, pasture, and woodland. It has fair potential for cropland and good potential for pasture and woodland. The potential for sanitary facilities and building site development is poor or fair.

This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. The erosion hazard is severe in cultivated areas, especially if the area is plowed in the fall. Including grasses and legumes in the cropping system helps to control erosion and maintain tilth in cultivated areas. The surface layer crusts after hard rains. After it is plowed when wet and sticky, the soil is cloddy. Minimizing tillage, planting cover crops, incorporating crop residue into the soil, and tilling at proper moisture levels increase the rate of water infiltration and reduce crusting, soil compaction, and the risk of erosion.

The use of this soil for pasture is effective in controlling erosion. Overgrazing or grazing during wet periods, when the soil is soft and sticky, causes surface compaction, excessive runoff, and poor tilth. The pasture can be reseeded with cover crops or companion crops or by trash-mulch or no-till seeding methods. Pasture rotation and restricted use during wet periods keep the pasture and the soil in good condition.

This soil is well suited to trees. Plant competition can be reduced by spraying, mowing, or disking. Protection against erosion is needed on logging roads and skid trails.

The moderate depth to bedrock, the slope, the moderately slow permeability, a moderate shrink-swell potential, and insufficient strength limit the use of this soil as a site for buildings and sanitary facilities. These limitations can be partly overcome through proper design and installation procedures. Providing suitable base material improves local roads.

Capability subclass IIIe; woodland suitability subclass 2o.

**MoB—Milton silt loam, 2 to 6 percent slopes.** This moderately deep, gently sloping, well drained soil is on knolls and side slopes at the head of drainageways. Most areas are irregularly shaped and range from 10 to 30 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is about 16 inches thick. The upper part is yellowish brown, firm silty clay loam; the lower part is dark yellowish brown, firm clay. Limestone bedrock is at a depth of about 23 inches.

Included with this soil in mapping are small areas of somewhat poorly drained soils that are underlain by bedrock at a depth of 20 to 40 inches. These soils are in drainageways.

Permeability is moderate or moderately slow. Runoff is medium. The root zone is moderately deep to limestone bedrock and has a low available water capacity. Organic-matter content is moderate. The surface layer can be easily tilled throughout a fairly wide range in moisture content. The upper part of the subsoil is slightly acid or neutral, and the lower part is neutral or mildly alkaline.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. The potential is fair for building site development and poor for sanitary facilities.

This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If the soil is cultivated, erosion is a hazard. The surface layer crusts and puddles after hard rains. Minimizing tillage, planting cover crops, incorporating crop residue into the soil, and establishing grassed waterways increase the rate of water infiltration and reduce crusting and the risk of erosion.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing during wet periods, when the soil is soft and sticky, causes surface compaction, excessive runoff, and poor tilth. Pasture rotation and restricted use during wet periods keep the pasture and the soil in good condition.

This soil is well suited to trees. A few small areas support native hardwoods. Plant competition can be reduced by spraying, mowing, or disking.

The moderate depth to bedrock, a moderate shrink-swell potential, and the moderate or moderately slow permeability limit this soil as a site for buildings and sanitary facilities. Also, the effluent from sanitary facilities can move through fissures in the limestone bedrock and pollute underground water supplies. Sanitary facilities should be connected to central sewers if possible. This soil is better suited as a site for houses without basements than as a site for houses with basements because blasting of bedrock generally is needed before a basement can be constructed. Local roads can be improved by replacing the surface layer and subsoil with suitable base material.

Capability subclass IIe; woodland suitability subclass 2o.

**MoC2—Milton silt loam, 6 to 12 percent slopes, moderately eroded.** This moderately deep, sloping, well drained soil is on knolls and side slopes at the head of drainageways. Most areas are irregularly shaped and range from 5 to 30 acres in size.

Typically, the surface layer is brown, friable silt loam about 6 inches thick. The subsoil is brown, firm clay about 24 inches thick. Limestone bedrock is at depth of about 30 inches.

Included with this soil in mapping are areas on the upper part of slopes where the surface layer is brown silty clay loam.

Permeability is moderate or moderately slow. Runoff is rapid. The root zone is moderately deep to limestone bedrock and has a low available water capacity. Organic-matter content is moderately low. Tilth is fair. The upper part of the subsoil is slightly acid or neutral, and the lower part is neutral or mildly alkaline.

Most of the acreage is cropland or pasture. This soil has fair potential for cropland and good potential for pasture and woodland. The potential is fair or poor for building site development and poor for sanitary facilities.

This soil is not well suited to row crops because of the low available water capacity and the erosion hazard. If erosion is controlled, row crops can be grown. The cropping system should include close-growing crops and grasses and legumes that provide a large amount of crop residue. The surface layer crusts after heavy rains. After it is plowed when wet and sticky, the soil is cloddy. Minimizing tillage, planting cover crops, establishing grassed waterways, and tilling at proper moisture levels improve tilth, increase the rate of water infiltration, and reduce the risk of erosion.

This soil is well suited to hay and pasture. Surface compaction, poor tilth, increased runoff, and reduced productivity result from overgrazing and from grazing during wet periods, when the soil is soft and sticky. Pasture rotation and timely deferment of grazing keep the pasture and the soil in good condition.

Some areas support native hardwoods. This soil is suited to trees and other vegetation grown as habitat for wildlife. Plant competition can be reduced by spraying, mowing, and disking. Protection against erosion is needed on logging roads and skid trails.

The moderate depth to bedrock, a moderate shrink-swell potential, the slope, and the moderate or moderately slow permeability limit this soil as a site for buildings and sanitary facilities. Also, the effluent from sanitary facilities can move through fissures in the limestone bedrock and pollute underground water supplies. Sanitary facilities should be connected to central sewers if possible. Blasting of bedrock generally is needed before a basement can be constructed. Local roads can be improved by replacing the surface layer and subsoil with suitable base material.

Capability subclass IIIe; woodland suitability subclass 2o.

**MoD2—Milton silt loam, 12 to 18 percent slopes, moderately eroded.** This moderately deep, moderately steep, well drained soil is along drainageways. Most areas are long and narrow and range from 10 to 50 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 6 inches thick. The subsoil is about 28 inches thick. The upper part is brown, firm clay; the lower part is dark brown and dark yellowish brown, firm clay and clay loam. Limestone bedrock is at a depth of about 34 inches.

Included with this soil in mapping are small areas of soils that have bedrock within a depth of 20 inches.

Permeability is moderate or moderately slow. Runoff is very rapid. Available water capacity is low, and the soil is droughty during extended dry periods. Organic-matter content is moderately low. The surface layer can be easily tilled throughout a fairly wide range in moisture content. The upper part of the subsoil is slightly acid or neutral, and the lower part is neutral or mildly alkaline.

Most of the acreage is cropland, hayland, or pasture. This soil has poor potential for cropland and fair potential for permanent pasture. The potential for building site development and sanitary facilities is poor.

The slope and the low available water capacity severely limit the use of this soil for row crops and small grain. The major management problem is controlling erosion. If good management is applied, row crops can be grown occasionally in areas that are being reseeded. The slope hinders machinery and the installation of erosion-control measures. After it is plowed when sticky and wet, the soil is cloddy. It puddles and crusts easily. Minimizing tillage, returning crop residue to the soil, and establishing grassed waterways help to control erosion, increase the rate of water infiltration, and improve tilth.

The use of this soil for pasture is effective in controlling erosion. Surface compaction, poor tilth, increased runoff, and reduced productivity result from overgrazing and from grazing during wet periods, when the soil is soft and sticky. Drought-resistant grasses and legumes should be selected in new seedings. The pasture can be reseeded with cover crops or companion crops or by trash-mulch or no-till seeding methods. Pasture rotation and timely deferment of grazing keep the pasture and the soil in good contiion.

The soil is well suited to trees. Some areas support native hardwoods. Plant competition can be reduced by spraying, mowing, or disking. The slope moderately limits the use of equipment. Logging roads and skid trails should be protected against erosion and established across the slope if possible. This soil has good potential as habitat for woodland wildlife.

The slope, the moderate depth to bedrock, and the moderate or moderately slow permeability severely limit the use of this soil as a site for buildings and sanitary facilities. Trails in recreation areas should be protected against erosion and laid out on the contour if possible.

Capability subclass IVe; woodland suitability subclass 2r.

**Mt—Montgomery silty clay loam.** This deep, nearly level, very poorly drained soil is in flat or depressional areas on till plains and slack water terraces. In the lower parts of depressions, it can be ponded by runoff from adjacent higher lying soils. Slope is 0 to 2 percent. Most areas are round or irregularly shaped and range from 20 to 400 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 10 inches thick. The subsurface layer is very dark gray, mottled, firm silty clay about 6 inches thick. The subsoil is mottled, firm silty clay about 30 inches thick. The upper part is dark gray; the lower part is light olive brown. The substratum to a depth of about 68 inches is light olive brown, calcareous, firm silty clay. It is mottled in the upper part.

Included with this soil in mapping are areas where the surface layer is silty clay and tilth is poor.

The seasonal high water table is near the surface in winter and in spring and other extended wet periods. Permeability is slow or very slow. Runoff is very slow or ponded. The root zone is deep and has a high available water capacity. This soil can be tilled within a narrow range of moisture content. Organic-matter content is high. The subsoil is slightly acid to mildly alkaline.

Most of the acreage is farmed. This soil has good potential for cropland, pasture, and woodland and as habitat for wetland wildlife. The potential for building site development and sanitary facilities is poor.

If artificially drained, this soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If optimum management is applied, row crops can be grown year after year. Most cropped areas have been drained. Seasonal wetness is the main limitation on cropland. Subsurface drains and open ditches commonly provide drainage. The soil becomes compact and cloddy if tilled during wet periods, when it is soft and sticky. Incorporating crop residue or other organic material into the surface layer and planting cover crops improve tilth and increase the rate of water infiltration.

This soil is suited to pasture and hay. Surface compaction, poor tilth, reduced growth, and a decreased infiltration rate result from overgrazing or grazing during wet periods. Plant selection, pasture rotation, and timely deferment of grazing keep the pasture and the soil in good condition.

This soil is suited to trees that can grow on wet sites. Seedlings grow well if competing vegetation is controlled or removed by spraying, mowing, or disking. Survival and growth rates can be increased by good site preparation. Logging can be done during the drier part of the year.

The wetness, the slow or very slow permeability, and a high shrink-swell potential severely limit this soil as a site for buildings and sanitary facilities. Surface drains and storm sewers can remove surface water. Providing artificial drainage and suitable base material improves local roads.

Capability subclass IIIw; woodland suitability subclass 2w.

**MyC2—Morley silt loam, 6 to 12 percent slopes, moderately eroded.** This deep, sloping, well drained soil occurs as long and narrow areas on convex ridgetops, on side slopes above steeper areas, and along well defined waterways. Most areas are 5 to 25 acres in size.

Typically, the surface layer is brown, firm silt loam about 8 inches thick. The subsoil is yellowish brown, firm clay and clay loam about 19 inches thick. The substratum to a depth of about 60 inches is yellowish brown, calcareous, firm clay loam.

Included with this soil in mapping are small areas of Blount soils along drainageways and Glynwood soils on the lower part of slopes. Also included are small areas of a severely eroded soil that has a yellowish brown silty clay loam surface layer.

Permeability is slow. Available water capacity is moderate. Runoff is rapid. The soil is droughty during extended dry periods because water is lost as runoff. The root zone is mainly moderately deep to compact glacial till. Organic-matter content is moderately low. The surface layer can be easily tilled throughout a fairly wide range in moisture content. The upper part of the subsoil is slightly acid or neutral, and the lower part is neutral or mildly alkaline.

Most of the acreage is farmed. This soil has fair potential for cultivated crops and good potential for hay, pasture, and trees. The potential is fair for building site development and poor or fair for sanitary facilities.

This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion damage can occur. Including grasses and legumes in the cropping system helps to control erosion and maintain tilth in cultivated areas. A few areas have long, smooth slopes that can be farmed on the contour. After it is plowed when wet and sticky, the soil is cloddy. It puddles and crusts easily. Minimizing tillage, planting cover crops, incorporating crop residue into the soil, and tilling at proper moisture levels increase the rate of water infiltration and reduce crusting and the risk of erosion.

Surface compaction, poor tilth, reduced productivity, and increased runoff result from overgrazing and from grazing when the soil is too wet. Proper stocking rates, plant selection, pasture rotation, timely deferment grazing, and applications of a proper amount and kind of fertilizer keep the pasture and the soil in good condition.

This soil is well suited to trees. A few areas support native hardwoods. Seedlings survive and grow well if competing vegetation is controlled or removed by spraying, mowing, or disking.

The slope, the slow permeability, some seasonal wetness, and the shrink-swell potential moderately limit this soil as a site for buildings and sanitary facilities. The soil is suited to these uses only if proper design and installa-

tion procedures are used. Providing suitable base material improves local roads by overcoming the risk of damage caused by low strength. This soil is suitable for pond embankments.

Capability subclass IIIe; woodland suitability subclass 2o.

**MyD2—Morley silt loam, 12 to 18 percent slopes, moderately eroded.** This deep, moderately steep, well drained soil is on convex ridgetops, on side slopes above steeper areas, and along well defined waterways. Areas are long and narrow or irregularly shaped and range from 10 to 70 acres.

Typically, the surface layer is brown, firm silt loam about 6 inches thick. The subsoil is yellowish brown and dark yellowish brown, firm clay about 14 inches thick. The substratum to a depth of about 60 inches is yellowish brown, calcareous, firm clay loam.

Included with this soil in mapping are narrow strips where slopes are 18 to 25 percent. Also included are small areas of severely eroded soils that have a yellowish brown silty clay loam surface layer.

Permeability is slow. Available water capacity is moderate. Runoff is very rapid. The soil is droughty during extended dry periods because water is lost as runoff. The root zone is mainly moderately deep to compact glacial till. Organic-matter content is moderately low. Tilth is good. The upper part of the subsoil is slightly acid or neutral, and the lower part is neutral or mildly alkaline.

Most of the acreage is pasture. This soil has poor potential for cultivated crops and fair potential for hay. It has good potential for woodland and as habitat for woodland wildlife. The potential for sanitary facilities, building site development, and most recreation uses is poor.

This soil is better suited to hay and pasture than to row crops, but row crops can be grown occasionally if erosion is controlled and the soil is otherwise well managed. The main concerns of management are the very severe erosion hazard and maintenance of tilth. The slope causes some problems in the use of machinery and in the installation of erosion-control measures. After it is plowed when sticky and wet, the soil is cloddy. It puddles and crusts easily. Minimizing tillage, managing crop residue, planting cover crops, and tilling and harvesting at proper moisture levels help to control erosion, improve tilth, and increase the rate of water infiltration.

The use of this soil as pasture or hayland is effective in controlling erosion. Surface compaction, poor tilth, increased runoff, and reduced productivity result from overgrazing or grazing when the soil is too wet. Proper stocking rates, plant selection, pasture rotation, timely deferment of grazing, and applications of the proper kind and amount of fertilizer keep the pasture and the soil in good condition. Reseeding with cover crops or companion crops or by trash-mulch or no-till seeding methods reduces the risk of erosion.

A few areas support native hardwoods. This soil is well suited to trees. Seedlings survive and grow well if competing vegetation is controlled or removed by spraying, mowing, or disking. Logging roads and skid trails should be protected against erosion and established across the slope if possible.

The slope, the slow permeability, and some seasonal wetness severely limit this soil as a site for buildings and sanitary facilities. If proper design and installation procedures are used, the limitation imposed by slope can be partly overcome. Increased runoff and erosion are problems during construction. Trails in recreation areas should be protected against erosion and laid out on the contour if possible.

Capability subclass IVe; woodland suitability subclass 2r.

**Mz—Muskego muck.** This deep, nearly level, very poorly drained soil is in low areas on outwash plains and till plains. It is frequently flooded. Slope is 0 to 2 percent. Most areas are irregularly shaped and range from 20 to 80 acres in size.

Typically, the surface layer is very dark brown, friable muck about 5 inches thick. Below this, to a depth of about 47 inches, is dark brown, very dark brown, black, very dark grayish brown, and very dark gray, friable and firm muck. The substratum to a depth of about 75 inches is very dark grayish brown, slightly plastic sedimentary peat.

Water is near the surface and ponds for long periods. Permeability is moderately rapid to moderately slow in the muck and slow in the sedimentary peat. Runoff is very slow. The root zone is deep and has a very high available water capacity. It ranges from very strongly acid to neutral.

Most of the acreage is farmed. A few areas are used as habitat for wetland wildlife. This soil has good potential for cropland and pasture and as habitat for wetland wildlife. The potential for woodland, building site development, and sanitary facilities is poor.

The very poor natural drainage, the flooding, and the underlying sedimentary peat are the major limitations for farming. This soil is suitable as cropland if adequately drained. Cultivated crops are well suited and can be grown year after year if optimum management is applied. Small grain is not well suited because of the flooding and the possibility of lodging and frost heave. Subsurface drains and open ditches provide drainage. Constructing or maintaining outlets is expensive in some areas. Ditchbanks are unstable. Subsidence or shrinkage occurs after the soil is drained. As a result, subsurface drains are displaced. Because the soil is made up of fine particles, soil blowing is a major hazard in the larger areas. Planting cover crops, returning crop residue to the soil, establishing windbreaks, and irrigating reduce the risk of soil blowing.

This soil is suited to grasses grown for hay or pasture. Legumes, such as alfalfa, are not well suited because of frost heave. Water-tolerant grasses, especially reed canarygrass, grow well. Overgrazing and grazing during wet periods, when the soil is soft and sticky, damage the pasture.

This soil generally is not well suited to trees unless it is drained. Undrained areas support water-tolerant trees and some cattails, reeds, and sedges. Wetness seriously limits the use of logging equipment.

Flooding, wetness, seepage, and low strength severely limit this soil as a site for buildings and sanitary facilities. Local roads can be improved by replacing the organic deposit with suitable base material and by providing drainage. Undrained areas provide good habitat for duck, muskrat, and other kinds of wetland wildlife.

Capability subclass IVw; woodland suitability subclass 3w.

**NaA—Nappanee silt loam, 0 to 2 percent slopes.** This deep, nearly level, somewhat poorly drained soil occurs as broad areas on uplands. Most areas are irregularly shaped and 5 to 200 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsoil is brown, mottled, firm clay about 24 inches thick. The substratum to a depth of about 60 inches is yellowish brown, calcareous, firm silty clay and clay.

Included with this soil in mapping are small areas of Paulding soils in shallow depressions and drainageways.

The seasonal high water table is perched near the surface in winter and in spring and other extended wet periods. Permeability is very slow. Runoff is slow. The root zone is mainly moderately deep to compact glacial till. Available water capacity is moderate. Organic-matter content also is moderate. The shrink-swell potential is high. This soil tends to crust and puddle after heavy rains. The upper part of the subsoil is medium acid to neutral, and the lower part is neutral or mildly alkaline.

Most of the acreage is farmed. This soil has fair potential for cultivated crops and good potential for hay, pasture, and trees. The potential for sanitary facilities and building site development is poor.

This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay. It warms and dries slowly in spring. Wetness delays planting and limits the choice of crops. Surface and subsurface drains lower the water table, but water moves slowly into the subsurface drains. Cover crops, incorporation of crop residue into the soil, crop rotations, and tillage at proper moisture levels improve tilth and increase the organic-matter content. This soil can be worked within a narrow range in moisture content. Surface compaction occurs if the soil is tilled or crops are harvested during wet periods, when the soil is soft and sticky.

This soil is suitable for pasture. Overgrazing or grazing during wet periods, when the soil is soft and sticky, causes surface compaction, excessive runoff, and poor tilth. Pasture rotation and restricted use during wet periods keep the pasture and the soil in good condition.

This soil is suited to trees. A few small areas remain in native hardwoods. Species that can tolerate some wetness should be selected for new plantings. Plant competition can be reduced by spraying, mowing, and disking. The use of harvesting equipment is limited during wet periods.

The seasonal wetness, the very slow permeability, the high shrink-swell potential, and low strength severely limit the use of this soil as a site for buildings and sanitary facilities. Landscaping on building sites keeps water away from foundations. Foundations should be designed to prevent the structural damage caused by shrinking and swelling. Sanitary facilities should be connected to central sewers and treatment facilities if possible. Providing artificial drainage and suitable base material improves local roads.

Capability subclass IIIw; woodland suitability subclass 3c.

**NaB—Nappanee silt loam, 2 to 6 percent slopes.** This deep, gently sloping, somewhat poorly drained soil is on low knolls and along drainageways in the uplands. Most areas are irregularly shaped and 5 to 150 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsoil is brown, mottled, firm clay about 24 inches thick. The substratum to a depth of about 60 inches is yellowish brown, calcareous, firm silty clay and clay.

Included with this soil in mapping are small areas of St. Clair soils in the higher convex areas.

The seasonal high water table is perched near the surface in winter and in spring and other extended wet periods. Permeability is very slow. Runoff is medium. The root zone is mainly moderately deep to compact glacial till. Available water capacity is moderate. Organic-matter content also is moderate. The shrink-swell potential is high. The surface layer cracks during extremely dry periods (fig. 6). It tends to crust and puddle after heavy rains. The upper part of the subsoil is medium acid to neutral, and the lower part is neutral or mildly alkaline.

Most of the acreage is farmed. This soil has fair potential for cultivated crops and good potential for hay, pasture, and trees. The potential for sanitary facilities and building site development is poor.

This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay. Erosion, wetness, and surface crusting are the main management concerns. Undrained areas warm and dry slowly in spring. In drained areas the drainage system commonly is one of randomly spaced subsurface drains because the surface is uneven. Water moves slowly into these drains. This soil can be worked within a narrow range in moisture content. Soil compaction occurs if the soil is tilled or

crops are harvested during wet periods, when the soil is soft and sticky. Minimizing tillage, planting deep rooted cover crops, and incorporating crop residue or other organic material into the surface layer improve tilth, increase the infiltration rate, and reduce surface crusting and the risk of erosion. Leaving crop residue on the surface in the fall and not plowing until spring also help to protect the soil against erosion. Grassed waterways are needed.

This soil is suited to pasture. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Pasture rotation and restricted use during wet periods keep the pasture and the soil in good condition.

A few areas support native hardwoods. This soil is well suited to trees and shrubs that can withstand seasonal wetness. Reforestation with desirable species is difficult because of plant competition. Plant competition can be reduced by spraying, mowing, and disking. The use of harvesting equipment is limited during wet periods.

The seasonal wetness, the very slow permeability, the high shrink-swell potential, and low strength severely limit the use of this soil as a site for buildings and sanitary facilities. Landscaping on building sites keeps surface water away from foundations. Foundations should be designed to prevent the structural damage caused by shrinking and swelling. Sanitary facilities should be connected to central sewers and treatment facilities if possible. Providing artificial drainage and suitable base material improves local roads. Some areas are good sites for ponds (fig. 7).

Capability subclass IIIe; woodland suitability subclass 3c.

**NnA—Nineveh silt loam, 0 to 2 percent slopes.** This deep, nearly level, well drained soil is on broad flats on outwash plains and valley trains. Most areas are long and narrow and range from 5 to 50 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 9 inches thick. The subsurface layer is very dark grayish brown, friable silt loam about 7 inches thick. The subsoil is about 21 inches thick. The upper part is dark brown, firm silty clay loam and clay loam; the lower part is dark brown and dark yellowish brown, firm clay loam and gravelly loam. The substratum to a depth of about 60 inches is yellowish brown, calcareous, loose very gravelly sand.

Included with this soil in mapping are small areas on slight rises where the surface layer is gravelly loam. Available water capacity is lower in these included areas.

Permeability is moderate in the subsoil and very rapid in the substratum. Runoff is slow. The root zone is mainly moderately deep to sand and gravel and has a moderate available water capacity. Organic-matter content is moderate. The surface layer can be easily tilled throughout a fairly wide range in moisture content. The upper part of the subsoil is slightly acid or neutral, and the lower part is neutral or mildly alkaline.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, trees, building site development, and recreation uses.

This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Droughtiness is the main limitation on cropland. The soil is well suited to irrigation. Crops can be seeded early because the soil warms and dries early in spring. Row crops can be grown year after year if optimum management is applied. Returning crop residue to the soil or regularly adding other organic material and minimizing tillage improve fertility, reduce crusting, and increase the rate of water intake.

Overgrazing pasture or grazing during wet periods, when the soil is soft and sticky, causes compaction and poor tilth. Pasture rotation and deferment of grazing during wet periods keep the pasture and the soil in good condition.

This soil is suited to trees. Plant competition can be reduced by spraying, mowing, and disking.

Although low strength and the shrink-swell potential are moderate limitations, this soil is suitable as a site for buildings. The low strength can be overcome by extending the building foundation to the substratum. Local roads can be improved by replacing the subsoil with suitable base material. The possible pollution of underground water supplies limits this soil as a site for sanitary facilities. Lawns are adversely affected by droughtiness during dry periods. The soil is a good source of sand and gravel.

Capability subclass IIs; woodland suitability subclass 1o.

**OcA—Ockley silt loam, 0 to 2 percent slopes.** This deep, nearly level, well drained soil occurs as broad areas on outwash terraces. Most areas are long and narrow or irregularly shaped and 5 to 70 acres in size.

Typically, the surface layer is brown, friable silt loam about 10 inches thick. The subsoil is about 35 inches thick. The upper part is dark yellowish brown, friable silt loam and firm clay loam; the next part is brown, firm clay; the lower part is dark brown, firm clay loam and gravelly clay loam. The substratum to a depth of about 60 inches is brown, calcareous, loose very gravelly sand.

Included with this soil in mapping are small areas of well drained Eldean soils on slight rises.

Permeability is moderate in the subsoil and very rapid in the substratum. Runoff is slow. The root zone is deep and has a moderate or high available water capacity. Organic-matter content is moderate. The surface layer can be easily tilled throughout a fairly wide range in moisture content. It tends to crust, however, after heavy rains. The upper part of the subsoil ranges from very strongly acid to medium acid. The acidity decreases with increasing depth.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, trees, building site development, and recreation uses.

This soil is suited to all of the crops commonly grown in the county. It is well suited to row crops grown year after year (fig. 8) and to specialty crops. It can be tilled and grazed early in spring and is well suited to irrigation. The main management concerns are maintaining a high level of fertility and good soil structure. Minimizing tillage, planting cover crops, and incorporating crop residue or other organic material into the surface layer maintain tilth, increase the infiltration rate, and reduce crusting.

This soil is well suited to pasture. Surface compaction, poor tilth, and a decreased infiltration rate result from overgrazing and from grazing during wet periods, when the soil is soft and sticky. Pasture rotation and timely deferment of grazing keep the pasture and the soil in good condition.

This soil is well suited to trees. Seedlings are easily established if competing vegetation is controlled or removed. Plant competition can be reduced by spraying, mowing, or disking.

Even though the shrink-swell potential and low strength are moderate limitations, this soil is well suited to building site development. These limitations can be partly overcome by extending foundations to the underlying sand and gravel and by backfilling with suitable material. Local roads can be improved by providing suitable base material. The possible contamination of ground water limits the use of this soil as a site for some sanitary facilities. The soil is well suited to recreation uses. It is a good source of sand and gravel.

Capability class I; woodland suitability subclass 1o.

**OcB—Ockley silt loam, 2 to 6 percent slopes.** This deep, gently sloping, well drained soil is on low rises on broad outwash terraces. Most areas are long and narrow or irregularly shaped and 5 to 35 acres in size.

Typically, the surface layer is brown, friable silt loam about 10 inches thick. The subsoil is about 33 inches thick. The upper part is yellowish brown, friable silt loam and firm silty clay loam; the lower part is brown or dark brown, firm silty clay loam and gravelly clay loam. The substratum to a depth of about 60 inches is brown, calcareous, loose very gravelly sand.

Included with this soil in mapping are small areas of Eldean soils in the higher convex areas on the landscape.

Permeability is moderate in the subsoil and very rapid in the substratum. Runoff is medium. The root zone is deep and has a moderate or high available water capacity. Organic-matter content is moderate. The surface layer can be easily tilled throughout a fairly wide range in moisture content. It tends to crust, however, after heavy rains. The upper part of the subsoil ranges from very strongly acid to medium acid. The acidity decreases with increasing depth.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, trees, building site development, and recreation uses.

This soil is suited to all of the crops commonly grown in the county. Row crops can be grown year after year if erosion is controlled. The soil dries early in spring. It is suited to irrigation and minimum tillage. The major management concern is control of erosion, especially on long slopes. Managing crop residue and planting cover crops commonly reduce the risk of erosion, conserve moisture, and maintain organic-matter content and tilth.

The use of this soil as pastureland or hayland is effective in controlling erosion. The soil is well suited to grazing early in spring. Overgrazing or grazing during wet periods, when the soil is soft and sticky, causes surface compaction, excessive runoff, and poor tilth. Pasture rotation and restricted use during wet periods keep the pasture and the soil in good condition.

This soil is well suited to trees, but only a few areas remain in native hardwoods. Seedlings are easily established if competing vegetation is controlled or removed. Plant competition can be reduced by spraying, mowing, or disking.

Even though the shrink-swell potential and the low strength are moderate limitations, this soil is suited to building site development. These limitations can be partly overcome by extending foundations to the underlying sand and gravel and by backfilling with suitable material. Local roads can be improved by providing suitable base material. The possible contamination of ground water limits the use of this soil as a site for some sanitary facilities. The soil is well suited to most recreation uses. It is a good source of sand and gravel.

Capability subclass IIe; woodland suitability subclass 1o.

**PaB—Parr silt loam, 1 to 4 percent slopes.** This deep, nearly level and gently sloping, well drained soil is on low rises in the uplands. Most areas are irregularly shaped and 50 to 200 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 10 inches thick. The subsurface layer is very dark grayish brown, friable silt loam about 4 inches thick. The subsoil is about 25 inches thick. The upper part is dark yellowish brown, firm silt loam and silty clay loam; the lower part is yellowish brown and brown, firm clay loam. The substratum to a depth of about 66 inches is brown and yellowish brown, calcareous, firm clay loam and loam.

Included with this soil in mapping are narrow strips of Crosby soils on the lower part of slopes and in drainageways.

Permeability is moderate or moderately slow. Runoff is slow or medium. The root zone is mainly moderately deep to compact glacial till. Available water capacity is high. Organic-matter content also is high. Tilth is good. The subsoil is slightly acid or medium acid.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. The potential is good for building site development and fair or good for sanitary facilities.

This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Minimizing tillage, planting cover crops, and incorporating crop residue into the soil maintain tilth, increase the rate of water infiltration, reduce crusting, and improve soil-seed contact. Surface compaction, poor tilth, and decreased infiltration result from overgrazing and from grazing during wet periods, when the soil is soft and sticky. Pasture rotation and timely deferment of grazing keep the pasture and the soil in good condition.

This soil is suited as a site for buildings and sanitary facilities if proper design and installation procedures are used. Local roads can be improved by providing suitable base material. The moderate or moderately slow permeability limits the use of this soil as a septic tank absorption field, but it can be partly overcome by increasing the size of the absorption area.

Capability class I; not assigned to a woodland suitability subclass.

**Pb—Patton silt loam.** This deep, nearly level, poorly drained soil is in depressional areas in the basins of former lakes. It receives runoff from adjacent higher lying soils and is subject to ponding. Slope is 0 to 2 percent. Most areas are circular and range from 30 to 150 acres in size.

Typically, the surface layer is black, friable silt loam about 6 inches thick. The subsurface layer is black, friable silt loam about 4 inches thick. The subsoil is mottled, friable silt loam about 17 inches thick. The upper part is gray; the lower part is light brownish gray. The substratum to a depth of about 60 inches is light brownish gray and gray, mottled, calcareous, friable silt loam.

Included with this soil in mapping are small areas of Henshaw soils in higher, slightly convex areas on the landscape.

The seasonal high water table is near the surface during extended wet periods. Permeability is moderate. Organic-matter content is high. Runoff is very slow or ponded. The root zone is mainly moderately deep to the substratum and has a high available water capacity. Tilth is good. The subsoil is slightly acid to mildly alkaline.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, and woodland. It has poor potential for building site development, sanitary facilities, and recreation uses.

If artificially drained, this soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Most cropped areas have been drained. Seasonal wetness is the principal limitation if the soil is farmed. Subsurface drains and open ditches commonly provide drainage. The soil can be cultivated year after year if optimum management is applied. Careful management is needed to maintain good tilth; the soil becomes compact and cloddy if it is tilled during wet periods, when it is soft and sticky. Managing crop residue and planting cover crops improve tilth and increase the rate of water infiltration.

Overgrazing pasture or grazing during wet periods, when the soil is soft and sticky, causes compaction and poor tilth. Pasture rotation and restricted use during wet periods keep the pasture and the soil in good condition.

This soil is suited to trees that are tolerant of wetness. If competing vegetation is controlled or removed by spraying, mowing, or disking, tree seedlings can survive and grow well. The use of tree planting and harvesting equipment is limited by wetness in winter and spring.

This soil is severely limited as a site for buildings, sanitary facilities, and recreation uses because of wetness and low strength. Artificial drainage is needed. Sanitary facilities should be connected to central sewers and treatment facilities if possible. Providing artificial drainage and suitable base material improves local roads.

Capability subclass IIw; woodland suitability subclass 2w.

**Pc—Patton Variant silt loam.** This deep, nearly level, poorly drained soil is in depressions in the basins of shallow lakes. It receives runoff from adjacent higher lying soils and is subject to ponding. Slope is 0 to 2 percent. Most areas are long and narrow or broad and range from 15 to 50 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 9 inches thick. The subsoil is gray and grayish brown, mottled, friable and firm silt loam about 35 inches thick. The substratum to a depth of about 60 inches is gray, mottled, calcareous, firm silt loam.

Included with this soil in mapping are small areas of the Martisco Variant in lower, slightly concave areas.

The seasonal high water table is near the surface in winter and in spring and other extended wet periods. Permeability is moderate. Organic-matter content also is moderate. The root zone is mainly moderately deep to the substratum and has a high available water capacity. Tilth is good. The subsoil is moderately alkaline.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, and woodland. The potential for building site development, sanitary facilities, and recreation uses is poor.

If artificially drained, this soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Seasonal wetness is the principal limitation if the soil is farmed. Subsurface drains and open ditches commonly provide drainage. The soil can be cultivated year after year if optimum management is applied. Careful management is needed to maintain good tilth; the soil becomes compact and cloddy if it is tilled when wet. The alkalinity of the surface layer and subsoil

adversely affects the response of plants to fertilizers. Acid-base fertilizers help to solve this problem.

Overgrazing pasture or grazing during wet periods, when the soil is soft and sticky, causes compaction and poor tilth. Pasture rotation and restricted use during wet periods keep the pasture and the soil in good condition.

This soil is suited to trees that are tolerant of wetness. If competing vegetation is controlled or removed by spraying, mowing, or disking, seedlings can survive and grow well. Wetness limits the use of tree planting and harvesting equipment in winter and spring.

Wetness and low strength severely limit this soil as a site for buildings and sanitary facilities. Providing artificial drainage and suitable base material improves local roads.

Capability subclass IIw; woodland suitability subclass 2w.

**Pd—Paulding clay.** This deep, nearly level, very poorly drained soil is on smooth flats on lake plains and in shallow depressions in the uplands. It is subject to ponding by runoff from adjacent higher lying soils. Most areas are irregularly shaped and range from 10 to 200 acres in size. Slope is 0 to 2 percent.

Typically, the surface layer is dark gray, firm clay about 11 inches thick. The subsoil is gray and light gray, mottled, firm clay about 40 inches thick. The substratum to a depth of about 60 inches is dark yellowish brown, mottled, firm, calcareous clay.

Included with this soil in mapping are small areas of Nappanee soils in slightly convex areas.

The seasonal high water table is perched at the surface in winter and in spring and other extended wet periods. Permeability is very slow. Runoff is very slow or ponded. The root zone is deep and has a moderate available water capacity. Organic-matter content is moderate. Tilth is poor. The upper part of the subsoil is slightly acid or neutral, and the lower part is neutral or mildly alkaline.

Most of the acreage is cultivated or pastured. This soil has fair potential for cultivated crops, hay, pasture, and woodland. The potential for building site development and sanitary facilities is poor.

Excessive wetness, poor tilth, and very slow permeability are the major limitations if cultivated crops are grown. This soil dries very slowly. Undrained areas are too wet for cultivated crops. Drained areas are suited to soybeans, corn, wheat, oats, and hay. Surface drains are generally more successful than subsurface drains in removing excess water. Water moves slowly into the subsurface drains even if good tilth is maintained. Tillage within a limited range of moisture content is important. The soil is hard and cloddy when dry and becomes sticky and puddled when wet. Hard clods interfere with the germination of seeds. Returning crop residue to the soil and planting cover crops increase the organic-matter content and the infiltration rate and improve tilth.

Drained areas are suited to pasture. Overgrazing or grazing during wet periods, when the soil is soft and sticky, causes surface compaction and poor tilth, decreases the infiltration rate, and reduces productivity. Plant selection, pasture rotation, and timely deferment of grazing keep the pasture and the soil in good condition.

This soil is suited to trees that are tolerant of wetness. Plant competition can be reduced by spraying, mowing, or disking. The use of tree planting and harvesting equipment is limited by wetness in winter and spring.

The prolonged wetness, low strength, a high shrink-swell potential, the very slow permeability, and the clay surface layer severely limit the use of this soil as a site for buildings, sanitary facilities, and recreation uses. Foundations should be designed to prevent the structural damage caused by low strength and shrinking and swelling. Sanitary facilities should be connected to central sewers and treatment facilities if possible. If local roads are built on this soil, artificial drainage and suitable base material are needed. Extensive drainage is needed in intensively used recreation areas, such as ball diamonds and tennis courts.

Capability subclass IIIw; woodland suitability subclass 3w.

**Pe—Pewamo silty clay loam.** This deep, nearly level, very poorly drained soil is in shallow depressions and drainageways on till plains. In the lower parts of the depressions, it is subject to ponding by runoff from higher lying adjacent soils. Most areas are irregularly shaped and range from 5 to 100 acres in size. Slope is 0 to 2 percent.

Typically, the surface layer is very dark gray, firm silty clay loam about 10 inches thick. The subsoil is very dark gray, dark gray, and gray, mottled, firm silty clay about 40 inches thick. The substratum to a depth of about 64 inches is gray, mottled, firm clay loam.

Included with this soil in mapping are small areas of Blount soils on slight rises.

The seasonal high water table is near the surface in winter and in spring and other extended wet periods. Permeability is moderately slow. The root zone is deep and has a high available water capacity. Runoff is very slow or ponded. Organic-matter content is high. The soil puddles and clods easily. The subsoil is slightly acid to mildly alkaline.

Most areas are farmed. This soil has good potential for crops, pasture, and woodland and poor potential for sanitary facilities, building site development, and recreation uses.

The very poor natural drainage is the main limitation if this soil is farmed. Drained areas are well suited to corn, soybeans, wheat, oats, hay, and pasture. In inadequately drained areas, stands of wheat and oats are poor in most years. A combination of surface and subsurface drains is commonly used to improve drainage. Tillage within a limited range of moisture content is important

because this soil is compact and cloddy after it has been worked when wet and sticky. Returning crop residue to the soil or regularly adding other organic material improves fertility, reduces clodding, and increases the infiltration rate.

The major concerns in managing pasture are overgrazing and grazing during wet periods, when the soil is soft and sticky. The surface compacts easily if the pasture is grazed when the soil is wet. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods keep the pasture and the soil in good condition.

Scattered small areas of this soil support native hardwoods. Trees that can tolerate wetness are needed in new plantings. Competing vegetation can be reduced by spraying, mowing, and disking. Wetness limits the use of tree planting and harvesting equipment in winter and spring.

This soil is severely limited as a site for buildings and sanitary facilities bcause of seasonal wetness, moderately slow permeability, and low strength. Surface drains and storm sewers can remove surface water. Providing artificial drainage and suitable base material improves local roads.

Capability subclass IIw; woodland suitability subclass 2w.

**Pg—Pits, gravel.** This map unit consists of surface-mined areas from which sand and gravel have been removed for use in construction. It commonly is on outwash terraces. Typically, the pits are adjacent to areas of Eldean, Fox, Ockley, and other soils that are underlain by glacial outwash. Most have a high wall on one or more sides. Most range from 10 to 60 acres in size. Actively mined pits are continually being enlarged.

The mined material consists of stratified layers of gravel and sand of varying thickness and orientation. The kind and grain size of the aggregates tends to be uniform within any one layer but commonly differs from layer to layer. Some layers contain a significant amount of silt and sand.

The material remaining after mining is poorly suited to plants. Organic-matter content and available water capacity are low.

Many of the gravel pits that are no longer used support weeds and trees. They could be developed as habitat for wildlife.

This map unit generally is not farmed or used for woodland. If the unit is used as a site for sanitary facilities, the effluent can pollute underground water supplies.

Not assigned to a capability subclass or woodland suitability subclass.

**Pk—Pits, quarries.** This map unit consists of surface-mined areas from which limestone bedrock has been removed for use in construction or farming. It commonly is on uplands. Typically, the quarries are adjacent to areas of Milton soils. Most range from 2 to 50 or more acres in size. Most have a high wall on one or more sides. Actively mined quarries are continually being enlarged.

Before the limestone is quarried, the overburden generally is scalped and stock piled. This material commonly is calcareous and has poor physical properties. The content of organic matter is very low. Available water capacity varies.

Areas that are no longer mined should be reclaimed and seeded to reduce the risk of erosion. Grasses and trees that can withstand a fairly low available water capacity and unfavorable soil properties are needed for seeding and planting.

Some areas can be developed for recreation and wildlife habitat.

Not assigned to a capability subclass or woodland suitability subclass.

**RoE—Rodman-Casco complex, 18 to 25 percent slopes.** This map unit consists of a deep, excessively drained Rodman soil and a deep, somewhat excessively drained Casco soil. These steep soils generally are on hillsides on outwash terraces and kames. The Rodman soil is mainly on the sides and tops of hills, and the Casco soil is on the lower part of hillsides. Areas range from 10 to 150 acres in size. They generally are 40 to 60 percent Rodman gravelly loam and 30 to 40 percent Casco gravelly loam. In some areas they are dominantly the Casco soil. The two soils are so intricately mixed that mapping them separately is not practical.

Typically, the Rodman soil has a surface layer of dark brown, friable gravelly loam about 9 inches thick. The subsoil is dark brown, friable very gravelly loam about 6 inches thick. The substratum to a depth of about 60 inches is yellowish brown, calcareous, loose very gravelly sand.

Typically, the Casco soil has a surface layer of dark brown, friable gravelly loam about 5 inches thick. The subsoil is dark yellowish brown, friable gravelly clay loam and gravelly sandy loam about 10 inches thick. The substratum to a depth of about 60 inches is yellowish brown, calcareous, loose very gravelly sand.

Included with these soils in mapping are are some narrow strips of Eldean soils on the lower part of slopes.

Permeability is moderately rapid in the subsoil of the Rodman soil and very rapid in the substratum. It is moderate in the subsoil of the Casco soil and very rapid in the substratum. In both of the soils the root zone dominantly is shallow to sand and gravel. Runoff is rapid. Organic-matter is moderate in the Rodman soil and low in the Casco soil. Available water capacity is very low in the Rodman soil and low in the Casco soil. The subsoil of the Rodman soil is mildly alkaline or moderately alkaline, and that of the Casco soil is neutral or mildly alkaline.

Most of the acreage is pasture or woodland. These soils have poor potential for cultivated crops, hay, sani-

tary facilities, and building site development. The potential is poor or fair for pasture and fair for trees.

The slope, the low or very low available water capacity, and the erosion hazard severely limit the use of these soils for cultivated crops. Erosion is a serious hazard if pasture is reseeded or the plant cover is inadequate. Seeding pasture by trash-mulch or no-till methods reduces the risk of erosion and conserves moisture. Establishing seedlings is difficult during dry periods. Proper stocking rates and pasture rotations keep the pasture in good condition.

These soils are suited to trees. Species selected for planting should be tolerant of a low or very low available water capacity. Seedling mortality is a hazard during dry years. The slope limits the use of equipment. Plant competition can be reduced by spraying, cutting, and disking.

The steep slope severely limits the use of these soils as sites for buildings and sanitary facilities. As much plant cover as possible is needed during construction. Lawns are adversely affected by droughtiness. Because of seepage, the effluent from sanitary facilities can pollute underground water supplies. Protection against erosion is needed on trails in recreation areas.

Capability subclass VIs; woodland suitability subclass 3s.

**RoF—Rodman-Casco complex, 25 to 50 percent slopes.** This map unit consists of an excessively drained Rodman soil and a somewhat excessively drained Casco soil. In most areas these deep, very steep soils are on hillsides on outwash terraces and kames. The Rodman soil is mainly on the sides and tops of hills, and the Casco soil is on the lower part of hillsides. Areas range from 10 to 100 acres in size. They are 40 to 60 percent Rodman gravelly loam and 30 to 40 percent Casco gravelly loam. The two soils are so intricately mixed that mapping them separately is not practical.

Typically, the Rodman soil has a surface layer of very dark grayish brown, friable gravelly loam about 8 inches thick. The subsoil is dark brown, friable very gravelly sandy loam about 4 inches thick. The substratum to a depth of about 60 inches is yellowish brown, calcareous, loose very gravelly sand.

Typically, the Casco soil has a surface layer of brown, friable gravelly loam about 4 inches thick. The subsoil is dark yellowish brown, firm gravelly sandy clay loam about 10 inches thick. The substratum to a depth of about 60 inches is yellowish brown, calcareous, loose very gravelly sand.

Permeability is moderately rapid in the subsoil of the Rodman soil and very rapid in the substratum. It is moderate in the subsoil of the Casco soil and very rapid in the substratum. Runoff is very rapid. Organic-matter is moderate in the Rodman soil and low in the Casco soil. The root zone in both soils is mainly shallow to sand and gravel. Available water capacity is very low in the Rodman soil and low in the Casco soil. The subsoil of the Rodman soil is mildly alkaline or moderately alkaline and that of the Casco soil is neutral or mildly alkaline.

Most of the acreage is pasture or woodland. These soils have poor potential for cultivated crops, hay, sanitary facilities, and building site development. They have fair potential for trees.

These soils are too steep for cultivated crops or hay and have limited potential for permanent pasture. The hazard of erosion is very severe if the plant cover is removed.

These soils are best suited to woodland and to wildlife habitat. During dry years seedlings do not grow well. The steep or very steep slope limits the use of harvesting equipment. It severely limits the use of planting and logging equipment. Seedling mortality is a hazard during dry years. Logging roads and skid trails should be protected against erosion and established across the slope if possible.

Capability subclass VIIs; woodland suitability subclass 3s.

**ScB—St. Clair silt loam, 2 to 6 percent slopes.** This deep, gently sloping, moderately well drained soil is on convex ridgetops, knolls, and short, uneven side slopes. Most areas are irregularly shaped and range from 15 to 200 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 22 inches thick. The upper part is yellowish brown, firm silty clay; the lower part is yellowish brown, calcareous, firm clay. The substratum to a depth of about 60 inches is yellowish brown, calcareous, firm clay.

Included with this soil in mapping are small areas of Nappanee and Paulding soils on flats and in shallow depressions and drainageways.

The seasonal high water table is perched between depths of 24 and 36 inches in spring and in other extended wet periods. Permeability is slow or very slow. Runoff is medium. The root zone is mainly moderately deep to compact glacial till. Available water capacity is moderate. Organic-matter content also is moderate. The surface soil can be worked within a narrow range in moisture content. It tends to crust or puddle after hard rains. The upper part of the subsoil is medium acid to neutral, and the lower part is slightly acid to mildly alkaline.

Most of the acreage is farmed. This soil has fair potential for cultivated crops and hay. The potential is good for pasture and woodland and poor for sanitary facilities and building site development.

This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. The main limitation in cultivated areas is the severe hazard of erosion. Row crops can be grown frequently if erosion is controlled. The surface layer can be worked within a narrow range of moisture content. It crusts and puddles after heavy rains. Minimizing tillage, planting cover crops,

returning crop residue to the soil, and establishing grassed waterways reduce the risk of erosion, improve tilth, and increase the rate of water infiltration.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Pasture rotation and restricted use during wet periods keep the pasture and the soil in good condition.

This soil is well suited to trees. A few small areas remain in native hardwoods. Species that can tolerate the high content of clay in the subsoil and substratum are needed in new plantings. Plant competition can be reduced by spraying, mowing, and disking.

A high shrink-swell potential, low strength, slow or very slow permeability, and some seasonal wetness severely limit the use of this soil as a site for buildings and sanitary facilitiies. Foundations should be designed to prevent the structural damage caused by shrinking and swelling. Sanitary facilities should be connected to central sewers and treatment facilities if possible. Providing artificial drainage and suitable base material improves local roads.

Capability subclass IIIe; woodland suitability subclass 2c.

**ScC2—St. Clair silt loam, 6 to 12 percent slopes, moderately eroded.** This deep, sloping, moderately well drained soil is on convex ridgetops and along well defined waterways. Most areas are irregularly shaped and 5 to 70 acres in size.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil is yellowish brown, firm clay about 19 inches thick. It is mottled in the lower part. The substratum to a depth of about 60 inches is yellowish brown, calcareous, firm clay.

Included with this soil in mapping are small areas of Nappanee soils on foot slopes and in shallow drainageways.

The seasonal high water table is perched between depths of 24 and 36 inches in spring and in other extended wet periods. Permeability is slow or very slow. Runoff is rapid. The root zone is mainly moderately deep to compact glacial till. Available water capacity is moderate. Organic-matter content is moderately low. The surface soil can be worked within a narrow range in moisture content. It tends to crust or puddle after hard rains. The upper part of the subsoil is medium acid to neutral, and the lower part is slightly acid to mildly alkaline.

Most of the acreage is used for hay, pasture, and small grain. This soil has fair potential for cultivated crops and hay. The potential is good for pasture and woodland and poor for sanitary facilities and building site development.

This soil is suited to small grain and hay. The erosion hazard is severe in cultivated areas. Row crops can be included in the cropping system if erosion is controlled and good tilth is maintained. This soil can be worked within a narrow range in moisture content. It crusts and puddles after heavy rains. After it has been plowed when wet and sticky, it is cloddy. Some areas have long slopes that can be stripcropped and farmed on the contour. Returning crop residue to the soil or regularly adding other organic material, minimizing tillage, and planting cover crops reduce crusting, increase the rate of water infiltration, and reduce the risk of erosion.

The use of this soil for pasture is effective in controlling erosion. Overgrazing or grazing when the soil is soft and sticky results in compaction, excessive runoff, poor tilth, and reduced growth. Pasture rotation and restricted use during wet periods keep the pasture and the soil in good condition.

This soil is well suited to trees. A few areas remain in native hardwoods. Species that can tolerate the high content of clay in the subsoil and substratum are needed in new plantings. Plant competition can be reduced by spraying, mowing, and disking.

A high shrink-swell potential, low strength, slow or very slow permeability, slope, and some seasonal wetness severely limit the use of this soil as a site for buildings and sanitary facilities. Foundations should be designed to prevent the structural damage caused by shrinking and swelling. Sanitary facilities should be connected to central sewers and treatment facilities if possible. Providing artificial drainage and suitable base material improves local roads.

Capability subclass IIIe; woodland suitability subclass 2c.

**ScD2—St. Clair silt loam, 12 to 18 percent slopes, moderately eroded.** This deep, moderately steep, moderately well drained soil is on convex ridgetops, on side slopes above steeper areas, and along well defined waterways. Most areas are irregularly shaped and 10 to 50 acres in size.

Typically, the surface layer is dark grayish brown and brown, friable silt loam about 7 inches thick. The subsoil is yellowish brown, mottled, firm silty clay about 21 inches thick. The substratum to a depth of about 60 inches is yellowish brown, calcareous, firm silty clay.

The seasonal high water table is in the lower part of the subsoil in spring and in other extended wet periods. Permeability is slow or very slow. Available water capacity is moderate. Runoff is very rapid. The soil is droughty during extended dry periods because water is lost as runoff. The root zone is mainly moderately deep to compact glacial till. Organic-matter content is moderately low. The surface soil can be worked within a narrow range in moisture content. The upper part of the subsoil is medium acid to neutral, and the lower part is slightly acid to mildly alkaline.

Most of the acreage is used for hay or pasture. This soil has poor potential for cultivated crops, fair potential for hay and pasture, and good potential for woodland.

The potential for sanitary facilities and building site development is poor.

This soil is better suited to hay and pasture than to row crops, but row crops can be grown occasionally if erosion is controlled and the soil is otherwise well managed. The main concerns of management are the very severe erosion hazard and maintenance of tilth. The slope limits the use of machinery and the installation of erosion-control measures. After it has been plowed when sticky and wet, the soil is cloddy. It puddles and crusts easily. Minimizing tillage, managing crop residue, planting cover crops, and tilling and harvesting at proper moisture levels help to control erosion and improve tilth.

Reseeding pasture with cover crops or companion crops or by trash-mulch or no-till seeding methods helps to control erosion. Controlled grazing reduces soil compaction and increases plant growth.

This soil is suited to trees. Some areas remain in native hardwoods. Species that can tolerate the high content of clay in the subsoil and substratum are needed in new plantings. The slope moderately limits the use of equipment. Logging roads and skid trails should be protected against erosion and established across the slope if possible.

This soil is not well suited as a site for buildings and sanitary facilities because of the slope, a high shrink-swell potential, the slow or very slow permeability, low strength, and some seasonal wetness. Foundations should be designed to prevent the structural damage caused by shrinking and swelling. As much plant cover as possible is needed during construction to reduce the erosion hazard. Trails in recreation areas should be protected against erosion and laid out on the contour if possible.

Capability subclass IVe; woodland suitability subclass 2c.

**ScE2—St. Clair silt loam, 18 to 35 percent slopes, moderately eroded.** This deep, steep and very steep, moderately well drained soil is along well defined waterways. Most areas are long and narrow and are 20 to 60 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 5 inches thick. The subsoil is dark yellowish brown, firm silty clay about 22 inches thick. It is mottled in the lower part. The substratum to a depth of about 60 inches is yellowish brown, calcareous, firm silty clay.

Included with this soil in mapping are long, narrow areas, in V-shaped ravines and valleys, where the slope is 35 to 50 percent.

The seasonal high water table is in the lower part of the subsoil in spring and in other extended wet periods. Permeability is slow or very slow. Available water capacity is moderate. Runoff is very rapid. The soil is droughty during extended dry periods because water is lost as runoff. The root zone is mainly moderately deep to compact glacial till. Organic-matter content is low. The upper part of the subsoil is medium acid to neutral, and the lower part is slightly acid to mildly alkaline.

Most of the acreage is pasture or woodland. This soil has poor potential for cropland, sanitary facilities, and building site development. It is best suited to woodland and to wildlife habitat.

The steep and very steep slope and the erosion hazard severely limit the use of this soil for farming. The soil is too steep for cultivated crops, but a few areas where the slope is 18 to 25 percent can be used for permanent pasture of grasses and legumes. Erosion is a serious hazard when pasture is reseeded or unless an adequate plant cover is maintained. Grazing should be regulated so that the plant cover is sufficient to control erosion. The growth of pasture plants is limited during dry periods in summer.

This soil is suited to trees. The slope moderately limits the use of logging equipment. Logging roads should be protected against erosion and established across the slope if possible.

The steep and very steep slope severely limits this soil as a site for buildings and sanitary facilities. As much plant cover as possible is needed to reduce the erosion hazard. Trails in recreational areas should be protected against erosion and established across the slope if possible.

Capability subclass VIIe; woodland suitability subclass 2c.

**SgB—Shinrock silt loam, 2 to 6 percent slopes.** This deep, gently sloping, moderately well drained soil is on convex knolls in the basins of former lakes. Most areas are irregularly shaped and range from 5 to 15 acres in size.

Typically, the surface layer is grayish brown, friable silt loam about 7 inches thick. The subsoil is about 35 inches thick. The upper part is brown, firm silty clay loam; the lower part is dark yellowish brown, mottled, firm silty clay. The substratum to a depth of about 60 inches is yellowish brown, calcareous, firm silty clay loam.

Included with this soil in mapping are small areas of Del Rey soils in shallow depressions and along drainageways.

The seasonal high water table is between depths of 18 and 36 inches in winter and in spring and other extended wet periods. Permeability is moderately slow. Runoff is medium. The root zone is mainly moderately deep to the compact substratum and has a moderate available water capacity. Organic-matter content is moderate. The surface layer can be easily tilled throughout a fairly wide range in moisture content. It tends to crust or puddle, however, after heavy rains. The upper part of the subsoil is strongly acid to slightly acid, and the lower part is medium acid to mildly alkaline.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. It has fair or poor potential for sanitary facilities and building site development.

This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If the soil is cultivated, erosion is a hazard. Minimizing tillage, planting cover crops, and establishing grassed waterways reduce the risk of erosion. Returning crop residue to the soil or regularly adding other organic material improves fertility, reduces crusting, and increases the rate of water infiltration. Randomly spaced subsurface drains are needed in the wetter included soils.

The use of this soil as pastureland or hayland is effective in controlling erosion. Controlled grazing is needed to prevent compaction, excessive runoff, and poor tilth. Pasture rotation and restricted use during wet periods keep the pasture and the soil in good condition.

This soil is well suited to trees. A few areas remain in native hardwoods. Tree seedlings survive and grow well if competing vegetation is controlled or removed by spraying, mowing, or disking.

The seasonal wetness, the moderately slow permeability, and the shrink-swell potential moderately limit this soil as a site for buildings and sanitary facilities. The soil is better suited to houses without basements than to houses with basements. The moderately slow permeability limits the effectiveness of septic tank effluent fields, but this limitation can be partly overcome by increasing the size of the absorption area. Providing artificial drainage and suitable base material improves local roads by overcoming the risk of damage caused by frost action and low strength.

Capability subclass IIe; woodland suitability subclass 2o.

**SgC—Shinrock silt loam, 6 to 12 percent slopes.** This deep, sloping, moderately well drained soil is on convex ridgetops and along drainageways. Most areas are long and narrow and range from 5 to 20 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsoil is about 21 inches thick. The upper part is dark yellowish brown, firm silty clay loam and silty clay; the lower part is yellowish brown, mottled, firm silty clay and silty clay loam. The substratum to a depth of about 60 inches is yellowish brown, calcareous, firm silty clay loam. The surface layer is dark yellowish brown silt loam in areas where plowing has mixed in the upper part of the subsoil.

Included with this soil in mapping are narrow strips where the slope is 18 to 25 percent.

The seasonal high water table is between depths of 18 and 36 inches in winter and in spring and other extended wet periods. Permeability is moderately slow. Runoff is rapid. The root zone is mainly moderately deep to the compact substratum and has a moderate available water capacity. Organic-matter content is moderate. The surface layer can be easily tilled throughout a fairly wide range in moisture content. It tends to crust or puddle, however, after heavy rains. The upper part of the subsoil is strongly acid to slightly acid, and the lower part is medium acid to mildly alkaline.

Most areas are farmed. This soil has fair potential for cultivated crops and good potential for hay, pasture, and trees. It has fair or poor potential for sanitary facilities and building site development.

This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If the soil is cultivated, the hazard of erosion is severe. Minimizing tillage, planting cover crops, and establishing grassed waterways help to prevent excessive soil loss. Some areas where slopes are long and smooth can be stripcropped or farmed on the contour. Returning crop residue to the soil or regularly adding other organic material improves fertility, reduces crusting, and increases the rate of water infiltration.

The use of this soil as pastureland or hayland is effective in controlling erosion. Overgrazing or grazing when the soil is soft and sticky results in surface compaction, excessive runoff, and reduced growth. Pasture rotation and restricted use during wet periods keep the pasture and the soil in good condition.

This soil is well suited to trees. A few small areas remain in native hardwoods. Tree seedlings survive and grow well if competing vegetation is controlled or removed by spraying, mowing, or disking. Protection against erosion is needed on logging roads.

The slope, the moderately slow permeability, and the shrink-swell potential moderately limit this soil as a site for buildings and sanitary facilities. As much plant cover as possible is needed during construction. The moderately slow permeability limits the effectiveness of septic tank absorption fields, but this limitation can be partly overcome by increasing the size of the absorption area. Providing suitable base material improves local roads.

Capability subclass IIIe; woodland suitability subclass 2o.

**Sh—Shoals silt loam.** This deep, nearly level, somewhat poorly drained soil is on flood plains. It is commonly flooded for brief periods in fall, winter, and spring. Most areas are long and narrow and range from 5 to 60 acres. Slope is 0 to 2 percent.

Typically, the surface layer is dark grayish brown, friable silt loam about 12 inches thick. The substratum to a depth of about 60 inches is dark grayish brown and dark brown, mottled, friable silt loam over grayish brown and yellowish brown, mottled, friable silt loam.

The seasonal high water table is between depths of 12 and 36 inches in winter and in spring and other extended wet periods. Permeability is moderate. Runoff is very slow. The surface layer can be easily tilled throughout a fairly wide range in moisture content. The

root zone is deep and has a high available water capacity. Organic-matter content is moderate or high. The upper 40 inches is slightly acid to mildly alkaline.

This soil is commonly used for cultivated crops and pasture. It has good potential for cropland, pasture, and woodland and poor potential for sanitary facilities and building site development.

Flooding and wetness are limitations on cropland. They delay planting in most years and limit the choice of crops. This soil is suited to corn and soybeans, which can be planted after the major threat of flooding. Winter grain can be severely damaged unless the crop is protected from floodwater. In places dikes help to control flooding. Subsurface drainage is needed, but suitable outlets are not available in some areas. Returning crop residue to the soil and planting cover crops reduce crusting, increase the rate of water intake, and protect the surface in areas that are subject to scouring.

This soil is suited to pasture, but maintaining tilth and desirable forage stands is difficult unless the soil is drained and grazing is controlled. Overgrazing or grazing during wet periods, when the soil is soft and sticky, causes surface compaction and poor tilth. Pasture rotation and deferment of grazing during wet periods keep the pasture and the soil in good condition.

This soil is suited to trees. A few areas remain in native hardwoods. Tree seedlings survive and grow well if competing vegetation is controlled or removed by spraying, mowing, or disking. Species that can tolerate some wetness are needed if an area is reforested.

The flood hazard and the seasonal wetness seriously limit this soil as a site for buildings and sanitary facilities. The soil has potential for such recreation areas as hiking trails, which can be used during the drier part of the year. Diking to control flooding is difficult. Providing fill and suitable base material improves local roads.

Capability subclass IIw; woodland suitability subclass 2o.

**SlA—Sleeth silt loam, 0 to 2 percent slopes.** This deep, nearly level, somewhat poorly drained soil occurs as circular or oblong areas on low rises and as long and narrow strips on terraces and outwash plains. Most areas are 5 to 80 acres in size.

Typically, the surface layer is dark brown, friable silt loam about 13 inches thick. The subsoil is about 32 inches thick. The upper part is dark grayish brown and dark gray, mottled, firm clay loam; the lower part is yellowish brown, dark yellowish brown, and grayish brown, mottled, firm clay loam and gravelly loam. The substratum to a depth of about 63 inches is brown, dark grayish brown, and gray, calcareous, loose very gravelly coarse sandy loam, very gravelly loamy coarse sand, and very gravelly coarse sand. In places the subsoil is less than 32 inches thick. In some areas the upper part of the subsoil is yellowish brown.

Included with this soil in mapping are narrow strips of Eldean soils on slight rises.

The seasonal high water table is between depths of 1 foot and 3 feet in winter, early in spring, and in other extended wet periods. Permeability is moderate in the subsoil and very rapid in the substratum. Runoff is slow. The root zone is deep and has a moderate available water capacity. Organic-matter content is moderate. The surface layer can be easily tilled throughout a fairly wide range in moisture content. The upper part of the subsoil is slightly acid or medium acid, and the lower part is neutral or mildly alkaline.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. The potential for sanitary facilities and building site development is poor.

This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Seasonal wetness is the main limitation in farmed areas. The soil warms slowly and dries late in spring in undrained areas. Most cropped areas have been drained. A subsurface drainage system is the most common method of drainage. Returning crop residue to the soil or adding other organic material maintains good tilth and reduces surface crusting. The soil should be tilled and crops harvested at optimum moisture levels and with the kind of equipment that minimizes soil compaction.

Overgrazing pasture or grazing during wet periods, when the soil is soft and sticky, causes poor tilth. Pasture rotation and restricted grazing during wet periods keep the pasture and the soil in good condition.

This soil is suited to trees that can withstand some seasonal wetness. Seedlings of suitable species survive and grow well if competing vegetation is reduced by spraying, mowing, and disking.

The seasonal high water table and seepage severely limit the use of this soil as a site for buildings and most sanitary facilities. The seepage can result in pollution of underground water supplies. Sanitary facilities should be connected to central sewers if possible. Drainage ditches and subsurface drains lower the seasonal high water table in areas where good outlets are available. Landscaping on building sites keeps surface water away from foundations. Foundation drains and protective exterior wall coatings help to keep basements dry. Providing artificial drainage and suitable base material improves local roads. Excavation is limited in winter and spring by the seasonal high water table and the sloughing of banks. Extensive drainage is needed in intensively used recreation areas, such as ball diamonds and tennis courts.

Capability subclass IIw; woodland suitability subclass 3o.

**So—Sloan silt loam.** This deep, nearly level, very poorly drained soil is in low lying areas on flood plains. It is frequently flooded for brief periods in winter and

spring. Most areas are long and narrow and range from 5 to 30 acres in size. Slope is 0 to 2 percent.

Typically, the surface layer is very dark grayish brown, friable silt loam about 6 inches thick. The subsurface layer is very dark grayish brown and very dark gray, friable silt loam and silty clay loam about 16 inches thick. It is mottled in the lower part. The subsoil is gray and yellowish brown, mottled, firm silty clay loam about 25 inches thick. The substratum to a depth of about 66 inches is gray, mottled, firm silty clay loam over gray, loose sandy loam.

Included with this soil in mapping are narrow strips of Shoals soils on very slight rises.

The seasonal high water table is near the surface in winter and in spring and other extended wet periods. Permeability is moderate or moderately slow. Runoff is very slow or ponded. The root zone is deep and has a high available water capacity. Organic-matter content is high. The upper part of the subsoil is slightly acid to mildly alkaline, and the lower part is neutral or mildly alkaline.

Most of the acreage is farmed. This soil has good potential for cropland, hay, pasture, and woodland and poor potential for sanitary facilities and building site development.

Flooding and seasonal wetness limit farming on this soil. Such a crop as winter wheat generally is not grown because of the flood hazard. Drained areas are suited to row crops. Surface drains commonly remove ponded water. Subsurface drains are used in areas where suitable outlets are available. Returning crop residue to the soil and planting cover crops maintain tilth, reduce crusting, and protect the surface in areas that are subject to scouring.

Overgrazing pasture or grazing during wet periods, when the soil is soft and sticky, causes compaction and poor tilth. Pasture rotation and deferment of grazing during wet periods keep the pasture and the soil in good condition.

This soil is suited to the trees that can grow on wet sites. Seedlings of suitable species survive and grow well if competing vegetation is controlled or removed by spraying, mowing, or disking. Wetness and flooding limit tree planting and harvesting.

Frequent flooding, prolonged wetness, and moderate or moderately slow permeability severely limit this soil as a site for buildings, sanitary facilities, and recreation uses. Diking to control flooding is difficult. Providing fill and suitable base material improves local roads.

Capability subclass IIIw; woodland suitability subclass 2w.

**Ud—Udorthents.** These soils occur as areas of cut and fill. In areas where the soil material has been removed, the remaining material typically is similar to the subsoil or substratum of adjacent soils. In fill or disposal areas, the characteristics of the soil material are more varied; this soil material generally is the subsoil and substratum of nearby soils. Slope ranges from 0 to 6 percent. Most areas range from 5 to 60 acres in size.

Typically, the upper 60 inches is silty clay loam, clay loam, silt loam, or clay. Available water capacity varies but dominantly is low. Permeability generally is slow. Tilth is poor. Hard rains tend to seal the surface, thus reducing the infiltration rate and restricting the emergence and growth of plants. A seasonal high water table is evident in some areas, particularly in graded areas that are depressed or bowl shaped. The root zone is neutral to moderately alkaline.

Most areas are new construction sites. In areas where the surface is bare, the erosion hazard is severe. Suitable plant cover is needed to control erosion. The suitability of these soils for building site development and sanitary facilities varies.

Not assigned to a capability subclass or woodland suitability subclass.

**Wa—Wallkill silt loam.** This deep, nearly level, very poorly drained soil is in depressions on terraces and uplands. It is subject to frequent flooding. Most areas are circular and range from 5 to 30 acres in size. Slope is 0 to 2 percent.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsoil is gray, friable silt loam about 8 inches thick. The substratum is gray, mottled friable silt loam about 4 inches thick. Below this to a depth of about 60 inches is black, friable muck.

Included with this soil in mapping are small areas of Carlisle and Muskego soils. These soils are near the center of the mapped areas.

Water is near the surface and ponds for long periods. Runoff is very slow. Permeability is moderate in the mineral soil and moderately rapid or rapid in the organic deposit. The root zone is deep and has a very high available water capacity. Organic-matter content is moderate. Tilth is good. The subsoil is commonly mildly alkaline.

Most of the acreage is woodland or cropland. This soil has good potential for cultivated crops, hay, and pasture. The potential for sanitary facilities, building site development, and recreation uses is poor.

If artificially drained, this soil is well suited to corn and soybeans and to grasses for hay and pasture. Seasonal wetness is the main limitation on cropland. Subsurface drains and open ditches commonly provide drainage. Draining some areas is difficult because adequate outlets are not available. Subsidence or shrinkage occurs in some areas as a result of oxidation of the organic material after the soil is drained. Returning crop residue to the soil or regularly adding other organic material improves fertility and reduces crusting.

Overgrazing pasture or grazing during wet periods, when the soil is soft and sticky, causes surface compaction and poor tilth. Pasture rotation and deferment of

grazing during wet periods keep the pasture and the soil in good condition.

This soil is suited to the trees that are tolerant of wetness. Competing vegetation around tree seedlings can be controlled by spraying, mowing, and disking. Planting and harvesting are limited by seasonal wetness.

Frequent flooding, wetness, seepage, and low strength seriously limit the use of this soil as a site for most sanitary facilities and buildings. Undrained areas provide good habitat for wetland wildlife.

Capability subclass IIIw; woodland suitability subclass 4w.

**WeA—Wea Variant silt loam, 0 to 2 percent slopes.** This deep, nearly level, well drained soil is on broad flats on valley trains. Most areas are long and narrow and range from 20 to 150 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 7 inches thick. The subsurface layer also is very dark grayish brown, friable silt loam about 7 inches thick. The subsoil to a depth of about 63 inches is, in sequence downward, dark brown, friable shaly silty clay loam; dark yellowish brown, firm shaly clay loam and very shaly clay; and dark yellowish brown, mottled, firm sandy clay loam.

Included with this soil in mapping are small areas of Gallman soils on convex, slightly higher areas.

Permeability is moderate. Runoff is slow. The root zone is deep and has a moderate available water capacity. Organic-matter content is high. The surface layer can be easily tilled throughout a fairly wide range in moisture content. The soil is slightly acid or neutral throughout.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, woodland, building site development, and recreation uses.

This soil is well suited to row crops grown year after year and to small grain. It can be tilled and grazed early in spring and is well suited to irrigation. The main management concern is maintaining high fertility and good soil structure. Minimizing tillage, planting cover crops, and returning crop residue to the soil or regularly adding other organic material maintain tilth, reduce crusting, and increase the infiltration rate.

This soil is well suited to pasture. Overgrazing or grazing during wet periods, when the soil is soft and sticky, causes compaction and poor tilth. Pasture rotation and deferment of grazing during wet periods keep the pasture and the soil in good condition.

The soil is suited to trees. Seedlings are easily established if competing vegetation is controlled or removed by spraying, mowing, or disking.

This soil is suitable as a site for buildings and onsite waste disposal if proper design and installation procedures are used. Walls and footings should be designed to prevent the structural damage caused by shrinking and swelling and moderately low strength. Local roads can be improved by providing suitable base material. Because of seepage, the effluent from sanitary facilities can pollute underground water supplies. This soil is well suited to recreation uses.

Capability class I; woodland suitability subclass 1o.

**WkF—Weikert shaly silt loam, 35 to 70 percent slopes.** This shallow, very steep, well drained soil is on dissected uplands. Most areas are irregularly shaped and 15 to 60 acres in size.

Typically, the surface layer is very dark gray, friable shaly silt loam about 2 inches thick. The subsurface layer is dark grayish brown, friable shaly silt loam about 4 inches thick. The subsoil is dark brown and brown, friable very shaly or shaly silt loam about 12 inches thick. Very dark brown shale bedrock is at a depth of about 18 inches.

Included with this soil in mapping are areas of Berks soils on the lower part of slopes.

Permeability is moderately rapid. Runoff is very rapid. The root zone is shallow to shale bedrock and has a very low available water capacity. Organic-matter content is low. The subsoil is medium acid to very strongly acid.

Most of the acreage is woodland. This soil has poor potential for most uses because of the very steep slope and the shallowness to bedrock. It has better potential for woodland, for woodland wildlife habitat, and for some recreation uses.

This soil is suited to trees. Establishing tree seedlings is difficult in most years. The slope severely limits the planting or harvesting of trees. Erosion is a serious hazard unless adequate plant cover is maintained. Skid roads should be protected against erosion and laid out on the contour if possible.

Construction for recreation and urban uses is very difficult on this soil. The hazard of erosion is very severe if the plant cover is removed. Trails in recreation areas should be protected against erosion and established across the slope if possible.

Capability subclass VIIe; woodland suitability subclass 4d.

**Wt—Westland silty clay loam.** This deep, nearly level, very poorly drained soil is in low lying areas on broad outwash terraces and valley trains. In the lower parts of depressions, it is subject to ponding by runoff from adjacent higher lying soils. Slope is 0 to 2 percent. Most areas are long and narrow or broad and are 10 to 150 acres in size.

Typically, the surface layer is black and very dark gray, friable silty clay loam about 12 inches thick. The subsoil is about 38 inches thick. The upper part is dark grayish brown, dark gray, and gray, mottled, firm clay loam; the lower part is gray and grayish brown, mottled, firm silty clay loam and gravelly silty clay loam. The substratum to a depth of about 60 inches is brown, calcareous, loose gravelly sand.

Included with this soil in mapping are small areas of Algiers soils in shallow depressions and drainageways.

The seasonal high water table is at the surface in fall and winter and in spring and other extended wet periods. Permeability is slow in the subsoil and very rapid in the substratum. Runoff is very slow or ponded. The root zone is deep and has a high available water capacity. Tilth is fair to good. Organic-matter content is high. The upper part of the subsoil is slightly acid or neutral, and the lower part is mildly alkaline or moderately alkaline.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. The potential for sanitary facilities and building site development is poor.

If artificially drained, this soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Unless adequate drainage is provided, poor stands of wheat and oats can be expected in most years. Most cropped areas have been drained. Row crops can be grown year after year if optimum management is applied. Subsurface drains and open ditches provide drainage. Timely tillage is important because the soil puddles and clods if worked during wet periods, when it is soft and sticky. Returning crop residue to the soil and planting cover crops improve tilth, reduce crusting, and increase the rate of water infiltration.

If this soil is pastured, controlled grazing is beneficial, even in drained areas. If the pasture is grazed during wet periods, when the soil is soft and sticky, the surface layer compacts easily, the compaction resulting in poor tilth.

This soil is suited to trees that are tolerant of wetness. A few areas support native hardwoods. Tree seedlings can survive and grow well only if competing vegetation is controlled or removed. Good site preparation and spraying, cutting, or girdling reduce plant competition. Wetness limits the use of planting and harvesting equipment during winter and spring.

Seasonal wetness, seepage, and ponding severely limit the use of this soil as a site for buildings and most sanitary facilities. Ditches are somewhat effective in controlling the water level if outlets are available. Excavation is limited during winter and spring by the seasonal high water table and the sloughing of banks. As a result of seepage, the effluent from sanitary facilities can pollute underground water supplies. Sanitary facilities should be connected to central sewers if possible. Suitable base material and artificial drainage are needed if the soil is used as a site for roads. Extensive drainage is needed in intensively used recreation areas, such as ball diamonds and tennis courts.

Capability subclass IIw; woodland suitability subclass 2w.

**Wu—Westland silty clay loam, clay substratum.** This deep, nearly level, very poorly drained soil is on narrow outwash terraces. In the lower parts of depressions, it is subject to ponding by runoff from adjacent higher lying soils. Slope is 0 to 2 percent. Most areas are long and narrow and range from 40 to 120 acres in size.

Typically, the surface layer is very dark gray, firm silty clay loam about 8 inches thick. The subsoil is about 35 inches thick. The upper part is dark gray, dark grayish brown, and gray, mottled, firm clay loam; the lower part is gray and grayish brown, mottled, firm gravelly loam and loam. The upper 9 inches of the substratum is gray and light gray, loose coarse sandy loam and loamy coarse sand. The lower part to a depth of about 60 inches is dark grayish brown, firm silty clay.

Included with this soil in mapping are small areas of Algiers soils in shallow depressions and drainageways.

The seasonal high water table is at the surface in fall and winter and in spring and other extended wet periods. Permeability is very slow. Runoff is very slow or ponded. The root zone is deep and has a high available water capacity. Tilth is fair to good. Organic-matter content is high. The upper part of the subsoil is slightly acid or neutral, and the lower part is mildly alkaline or moderately alkaline.

Most of the acreage is farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. The potential for sanitary facilities, building site development, and recreation uses is poor.

This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Row crops can be grown year after year if optimum management is applied. Seasonal wetness is the principal limitation on cropland. Subsurface drains and open ditches provide drainage. Timely tillage is important because the soil puddles and clods if worked during wet periods, when it is soft and sticky. Returning crop residue to the soil and planting cover crops increase the rate of water infiltration and reduce clodding and crusting.

If this soil is pastured, controlled grazing is beneficial, even in drained areas. If the pasture is grazed during wet periods, when the soil is soft and sticky, the surface soil compacts easily, the compaction resulting in poor tilth. Pasture rotation and restricted grazing during wet periods keep the pasture and the soil in good condition.

This soil is suited to the trees that are tolerant of wetness. Scattered small areas support native hardwoods. Tree seedlings can survive and grow well only if competing vegetation is controlled or removed. Wetness limits the use of planting and harvesting equipment during winter and spring.

This soil is severely limited as a site for buildings and sanitary facilities because of seasonal wetness, seepage, ponding, and very slow permeability. Surface drains and storm sewers can remove surface water. The foundations and footings of dwellings and small buildings with basements should be designed to prevent the structural damage caused by the low strength in the lower part of

the soil. Sanitary facilities should be connected to central sewers and treatment facilities if possible. Providing artificial drainage and suitable base material improves local roads. Extensive drainage is needed in intensively used recreation areas, such as ball diamonds and tennis courts.

Capability subclass IIw; woodland suitability subclass 2w.

**Wv—Wetzel silty clay loam.** This deep, nearly level, poorly drained soil is in shallow depressions and drainageways on ground moraines and end moraines. The lower parts of depressions are subject to ponding by runoff from adjacent higher lying soils. Slope is 0 to 2 percent. Most areas are irregularly shaped and range from 20 to 100 acres in size.

Typically, the surface layer is dark grayish brown, firm silty clay loam about 10 inches thick. The subsoil is gray and grayish brown, mottled, firm clay about 34 inches thick. The substratum to a depth of about 60 inches is gray, calcareous, firm clay loam.

Included with this soil in mapping are small areas of Pewamo soils in shallow depressions and drainageways and Blount soils on low knolls and foot slopes.

The seasonal high water table is near the surface in winter and in spring and other extended wet periods. Permeability is slow or moderately slow. Some areas in depressions receive runoff from adjacent soils. Runoff is very slow. The root zone is deep and has a high available water capacity. Organic-matter content is moderate. This soil puddles and clods easily. The upper part of the subsoil ranges from slightly acid to mildly alkaline and the lower part from neutral to moderately alkaline.

Most of the acreage is farmed. This soil has good potential for cultivated crops, pasture, and woodland. The potential for recreation uses, sanitary facilities, and building site development is poor.

Seasonal wetness is the principal limitation on cropland. Most cropped areas have been artificially drained. Drained areas are well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Surface and subsurface drains commonly improve drainage. Tillage within a limited range of moisture content is important because this soil is compacted and cloddy after it has been worked when wet and sticky. Returning crop residue to the soil or regularly adding other organic material improves tilth and increases the rate of water infiltration.

The principal concerns in managing pasture are overgrazing or grazing during wet periods, when the soil is soft and sticky. The surface soil compacts easily if the pasture is grazed when the soil is wet. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods keep the pasture and the soil in good condition.

This soil is suited to the trees that can tolerate seasonal wetness. Wetness limits the use of planting and harvesting equipment during winter and spring. Competing vegetation can be controlled by spraying, mowing, or disking.

This soil is severely limited as a site for buildings, sanitary facilities, and recreation uses because of seasonal wetness, slow or moderately slow permeability, and low strength. Ditches are somewhat effective in lowering the perched water table if outlets are available. Excavations are limited by wetness during winter and spring. Providing artificial drainage and suitable base material improves local roads. Extensive drainage is needed in intensively used recreation areas, such as ball diamonds and tennis courts.

Capability subclass IIw; woodland suitability subclass 3w.

**Wx—Willette muck.** This deep, nearly level, very poorly drained organic soil is in depressions in till plains, outwash plains, and lake plains. It is subject to frequent flooding. Slope is 0 to 2 percent. Most areas are circular and are 10 to 40 acres in size.

Typically, the surface layer is black, very friable muck about 7 inches thick. Below this, to a depth of about 34 inches, is very dark brown, very dark gray, and very dark grayish brown, very friable and friable muck. The substratum to a depth of about 60 inches is gray and dark grayish brown, firm silty clay. It is mottled in the upper part.

Included with this soil in mapping are small areas of Carlisle and Muskego soils.

Water is near the surface and ponds for long periods. Runoff is very slow. Permeability is moderately slow to moderately rapid in the muck and slow in the substratum. Organic-matter content is very high. The root zone is deep and has a very high available water capacity. Tilth is good. The muck below the surface layer ranges from medium acid to mildly alkaline.

Most of the acreage is farmed. This soil has good potential for most cultivated crops, for pasture, and as habitat for wetland wildlife. The potential for sanitary facilities, building site development, and recreation uses is very poor.

Very poor natural drainage and flooding are the major limitations if this soil is cultivated. Surface drains are commonly used to remove ponded water. Subsurface drains are also used, but draining some areas is difficult because adequate outlets are not available and clayey or silty material is close to the surface. Subsidence or shrinkage occurs as a result of oxidation of the organic material after the soil is drained. Controlled drainage in areas where the water table can be raised or lowered reduces the amount of shrinkage. During dry periods soil blowing and the risk of fire are the major hazards. The risk of soil blowing can be reduced by irrigation, windbreaks, and cover crops.

Drained areas are suited to pasture. A water-tolerant grass, such as reed canarygrass, grows well on this soil.

Overgrazing and grazing during wet periods, when the soil is soft and sticky, cause compaction and poor tilth. Pasture rotation and restricted use during wet periods keep the pasture and the soil in good condition.

Undrained areas support water-tolerant trees and some cattails, reeds, and sedges. The wetness seriously limits the use of logging equipment.

This soil is seriously limited as a site for buildings, sanitary facilities, and recreation uses by wetness, flooding, low strength, and seepage. Undrained areas provide good habitat for ducks, muskrat, and other wetland wildlife.

Capability subclass IIIw; woodland suitability subclass 4w.

# Use and management of the soils

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

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

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

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

Contractors can find information that is useful in locating sources of sand and gravel, roadfill, and topsoil. Other information indicates wetness or the presence of bedrock.

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

## Crops and pasture

David Nesser, district conservationist, Soil Conservation Service, helped prepare this section.

The major management concerns in the use of the soils for crops and pasture are described in this section. In addition, the crops or pasture plants best suited to the soil, including some not commonly grown in the survey area, are discussed; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are presented for each soil.

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

More than 231,000 acres in the survey area was used for crops and pasture in 1967, according to the Conservation Needs Inventory (*8*). Of this total, 41,000 acres was used for permanent pasture; 85,000 acres for row crops, mainly corn and soybeans; 29,000 acres for close-grown crops, mainly wheat and oats; and 54,000 acres for rotation hay and pasture. The rest was idle cropland.

The acreage used for crops and pasture in this county has not been affected by urban development to the extent that it has in other parts of the State. In 1967, an estimated 15,000 acres was urban and built-up land. The acreage of such land has been increasing at the rate of about 60 acres per year. The section "General soil map for broad land-use planning" indicates how this soil survey can help planners to make land-use decisions that will influence the future role of farming in the county.

*Soil erosion* is a major problem on about half of the cropland and pasture in Logan County. If the slope is more than 2 percent, erosion is a hazard. It is a hazard on Blount, Crosby, Del Rey, Haskins, Homer, and Nappanee soils, for example, which have a slope of 2 to 6 percent.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into a plow layer. Erosion is especially damaging on

soils with a clayey subsoil, such as Blount, Fulton, and Nappanee soils. It also reduces productivity on soils that tend to be droughty, such as Casco, Eldean, Fox, Gallman, Rodman, and Nineveh soils. Second, soil erosion on farmland results in sediment entering streams. Control of erosion minimizes the pollution of streams by sediment and improves the quality of water for municipal use, for recreation, and for fish and wildlife.

In eroded spots on many gently sloping and sloping fields, preparing a good seedbed and tilling are difficult because the original friable surface layer has been eroded away. Such spots are common in the moderately eroded Miamian, Morley, and St. Clair soils.

Erosion control measures provide protective surface cover, reduce runoff, and increase the infiltration rate. A cropping system that keeps plant cover on the soil for extended periods can hold soil losses to an amount that will not reduce the productive capacity of the soils. On livestock farms, where part of the acreage is pasture and hayland, including legume and grass forage crops in the cropping system not only provides nitrogen and improves tilth for the following crop but also reduces the risk of erosion.

Slopes are so short and irregular that contour tillage and terracing are not practical in most areas of Glynwood, Morley, and St. Clair soils. On these soils a cropping system that provides substantial plant cover is needed to control erosion unless the "no-till" method is applied. Applying the "no-till" method and leaving crop residue on the surface increase the infiltration rate and reduce the hazards of runoff and erosion. On the less well drained soils minimum tillage is very helpful in controlling erosion.

Erosion-control measures are suitable on many of the soils in the survey area but are less successful on the moderately eroded soils, particularly if severely eroded spots are common. No tillage for corn, which is common on an increasing acreage, is effective in controlling erosion on sloping soils and can be adapted to many of the soils in the survey area. It is less successful, however, on the soils that are severely eroded in many spots.

Terraces and diversions reduce the length of slopes, control runoff, and reduce the risk of erosion on long slopes. The soils in Logan County, however, are less well suited to terraces and diversions because of irregular slopes, excessive wetness in terrace channels, and a clayey subsoil, which would be exposed in the terrace channels.

Grassed waterways are natural or constructed outlets that are protected by grass cover. Natural drainageways are the best sites for waterways and commonly require a minimum of shaping to produce a good channel. They should be wide and flat so that farm machinery can cross them easily.

Contouring and contour stripcropping are helpful in controlling erosion, but their use is limited in Logan County because slopes are generally irregular. Contouring and even stripcropping are practical in some areas of Casco, Eldean, Miamian, Milton, Morley, St. Clair, and Shinrock soils.

*Soil blowing* is a hazard on Carlisle, Edwards, Linwood, Martisco, Muskego, and Willette soils. It can damage these soils, which have a muck or mucky surface layer, in a few hours if winds are strong and the soils are dry and bare of plant cover or surface mulch. Maintaining a plant cover or surface mulch or keeping the surface rough through proper tillage minimizes soil blowing on these soils. Also, windbreaks of suitable shrubs, such as Tartarian honeysuckle or autumn-olive, are effective in reducing the risk of soil blowing.

Information about the design of erosion-control practices for each kind of soil is contained in the Technical Guide, available in the local office of the Soil Conservation Service.

*Soil drainage* is the major management need on about half of the acreage used for crops and pasture in the survey area. Some soils are naturally so wet that production of the crops commonly grown in the area is generally not possible. These are the poorly drained and very poorly drained Brookston, Latty, Lippincott, Montgomery, Patton, Paulding, Pewamo, Sloan, Westland, and Wetzel soils, which make up about 63,000 acres of the survey area. The organic Carlisle, Edwards, Linwood, Martisco, Muskego, Wallkill, and Willette soils, which make up about 7,000 acres, also are very poorly drained.

Unless artificially drained, the somewhat poorly drained Algiers, Blount, Crosby, Del Rey, Fulton, Haskins, Henshaw, Homer, Nappanee, Shoals, and Sleeth soils are so wet that crops are damaged during most years. These soils make up about 101,000 acres of the survey area.

In Miamian and Morley soils natural drainage is good during most of the year, but these soils tend to dry out slowly after rains. Small areas of wetter soils along drainageways in swales and in slight depressions are commonly included with the moderately well drained Celina, Glynwood, St. Clair, Shinrock, and Eel soils in mapping. Artificial drainage is needed in some of these wetter areas.

The design of both surface and subsurface drainage systems varies with the kind of soil. A combination of surface drainage and subsurface drainage is needed in most areas of the poorly drained and very poorly drained soils that are intensively row cropped. Drains should be more closely spaced in slowly or very slowly permeable soils than in the more permeable soils. Subsurface drainage is very slow in Latty, Montgomery, and Paulding soils. Finding adequate outlets for subsurface drainage systems is difficult in many areas of Latty, Montgomery, Paulding, and Sloan soils.

Organic soils oxidize and subside when the pore space is filled with air; therefore, special drainage systems are needed to control the depth and the period of drainage. Keeping the water table at the level required

by crops during the growing season and raising it to the surface during other parts of the year minimize the oxidation and subsidence of organic soils.

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

*Irrigation* can increase crop production in Logan County. Rainfall is generally adequate for most crops but is not always timely or well distributed. Extended dry periods sometimes occur between June and September.

Many soils in the county can be irrigated for some crops if water is available. Features that affect the suitability of a soil for irrigation are available water capacity, slope, water intake rate, need for drainage, depth of the soil in relation to rooting depth, susceptibility to stream overflow, hazard of erosion, and presence of layers that limit water movement. Soils that have a slope of more than 6 percent are highly susceptible to erosion if they are irrigated.

Subirrigation is desirable in some organic soils, such as Carlisle soils. Water-level control gates in drainage ditches can maintain the water table at a depth of 12 to 30 inches, depending on the root zone requirements of the crop. Onsite investigation of the thickness of the organic deposit over marl or clayey or silty material is needed before a subirrigation system is installed.

*Soil fertility* is naturally low in many soils on the uplands in the survey area. Many soils that have a light colored surface layer are naturally acid. The soils on flood plains, such as the Eel, Genesee, Shoals, Sloan, and Wallkill soils, range from slightly acid to moderately alkaline and are naturally higher in content of plant nutrients than most upland soils. Brookston, Latty, Lippincott, Montgomery, Patton, Paulding, Pewamo, Westland, and Wetzel soils in low swales and drainageways are slightly acid or mildly alkaline.

Edwards, Linwood, Martisco, Carlisle, Muskego, and Willette soils range from strongly acid to moderately alkaline. In some areas special fertilizers are needed because these soils can be deficient in boron and other trace elements.

Many upland soils are naturally strongly acid or very strongly acid. If these soils have never been limed, applications of ground limestone are needed to raise the pH level sufficiently for good growth of alfalfa and other crops that grow on nearly 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. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime to apply.

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

Many of the soils used for crops in the survey area have a silt loam surface layer that is light in color and moderately low or moderate in content of organic matter. Generally, the structure of such soils is weak, and intense rainfall causes the formation of crust on the surface. The crust is hard when dry, and it is nearly impervious to water. Once the crust forms, it reduces the infiltration rate and increases runoff. Regular applications of crop residue, manure, and other organic material can improve soil structure and reduce the likelihood of crusting.

Fall plowing is generally not a good practice on the soils with a light colored silt loam surface layer because of crusting during winter and spring. Many of the soils that are plowed in the fall are nearly as dense and hard at planting time as they were before they were plowed. In addition, sloping soils, and even some areas of nearly level, light colored soils, are subject to erosion and soil blowing after they have been plowed in the fall.

The dark colored surface layer of Brookston, Lippincott, Montgomery, Patton, Pewamo, Sloan, and Westland soils and the surface layer of Latty, Paulding, and Wetzel soils contain more clay than that of the light colored soils in the county. Poor tilth can be a problem because these soils often stay wet until late in spring. After they have been plowed when wet, these soils tend to be very cloddy when dry. As a result, preparing good seedbeds is difficult. Fall plowing generally results in good tilth in the spring.

*Field crops* suited to the soils and climate of the survey area include many that are not now commonly grown. Corn and soybeans are the main row crops. Sugar beets, potatoes, grain sorghum, sunflowers, navy beans, and similar crops can be grown.

Wheat and oats are the most common close-growing crops. Rye, barley, and buckwheat could be grown, and grass seed could be produced from bromegrass, fescue, timothy, and bluegrass. Also, legume seed from red clover and alsike clover could be produced.

*Special crops* grown commercially in the survey area are vegetables, small fruits, tree fruits, nursery plants, and Christmas trees. A small acreage is used for melons, strawberries, raspberries, sweet corn, tomatoes, and other vegetables and small fruits. In addition, large areas are suited to other special crops, such as grapes and many vegetables. The apple is the most commonly grown tree fruit in the county.

Deep and moderately deep soils that have good natural drainage and warm up early in spring are especially well suited to many vegetables and small fruits. In this survey area, these are the Eldean, Fox, Gallman, Ockley, Parr, and Nineveh soils and the Wea Variant that have a slope of less than 6 percent. They make up about 18,000 acres of the survey area. Crops generally can be planted and harvested earlier on these soils than on the other soils in survey area.

If adequately drained, the soils with a muck surface layer are well suited to a wide range of vegetable crops. Carlisle, Edwards, Linwood, Martisco, Muskego, Wallkill, and Willette soils, which make up about 7,000 acres of the survey area, are examples.

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

The latest information about growing special crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

*Permanent pasture* makes up about 15 percent of the farmed acreage. The percentage is small because a large part of the farmed acreage can be grain cropped. Also, most of the forage is provided by meadow crops. Many soils in the county could be used for high-quality permanent pasture.

Many of the permanently pastured areas are eroded soils that formerly were cultivated, steeply sloping soils, and frequently flooded soils. Some permanent pastures near farmsteads are used for feedlots or access lanes. Some open woodlots are pastured, but they generally provide poor grazing because forage plants are sparse.

Yields of permanent pasture plants vary widely according to the kind of soil and the slope. Sloping to very steep soils, such as Casco, Eldean, Miamian, Milton, Morley, and St. Clair soils, are commonly eroded, and the amount of water available to plants is low because runoff is rapid. As a result, the growth of forage plants is restricted. These plants are much more productive on the gently sloping Blount, Celina, Crosby, Eldean, Glynwood, Miamian, Milton, Nappanee, and St. Clair soils, but these soils are subject to erosion if the plant cover is damaged by overgrazing. Severe soil compaction occurs if livestock graze and trample these soils during wet periods.

The Eel, Genesee, Shoals, Sloan, and Wallkill soils on flood plains are well suited to permanent pasture. Flooding during the growing season, which can seriously damage cash crops, is much less damaging on permanent pasture. Alluvial soils, which are fertile and have a high available water capacity, can produce good grass or grass-legume pasture. Surface and subsurface drains help to control excess water in the somewhat poorly drained and very poorly drained soils, particularly where legumes are grown. They generally are not needed in the better drained Eel and Genesee soils.

Management for permanent pasture is similar to management for cropland. Lime and fertilizer should be applied at rates indicated by soil tests. Controlling weeds by periodic clipping and by recommended herbicides encourages the growth of desirable pasture plants. Proper seeding rates and controlled grazing help to maintain well established permanent pastures. The latest information about seeding mixtures, herbicide treatment, and other management for specific soils 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 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. Absence of an estimated yield indicates that the crop is not suited to or not commonly grown on the soil.

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

The yields were estimated assuming that the latest soil and crop management practices were used. Hay and pasture yields were estimated for the most productive varieties of grasses and legumes suited to the climate and the soil. A few farmers may be obtaining average yields higher than those shown in table 5.

The management needed to achieve the indicated yields of the various crops depends on the kind of soil and the crop. Such management provides drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate tillage practices, including time of tillage and seedbed preparation and tilling when soil moisture is favorable; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residues, barnyard manure, and green-manure crops; harvesting crops with the smallest possible loss; and timeliness of all fieldwork.

The estimated yields reflect the productive capacity of the soils 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 5 are grown in the survey area, but estimated yields are not included because the acreage of these crops is small. The local offices of the Soil Conservation Service and the Cooperative Extension Service can provide information about the management concerns and productivity of the soils for these crops.

### Capability classes and subclasses

Capability classes and subclasses show, in a general way, the suitability of soils for most kinds of field crops. The soils are classed according to their limitations when they are used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and gen-

erally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to horticultural crops or other crops that require special management. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for forest trees or for engineering purposes.

In the capability system, all kinds of soil are grouped at three levels: capability class, subclass, and unit (*11*). The capability class and subclass are defined in the following paragraphs. A survey area may not have soils of all classes.

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

Class I soils have few limitations that restrict their use.

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

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

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

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

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

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

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

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

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

The acreage of soils in each capability class and subclass is indicated in table 6. All soils in the survey area except those named at a level higher than the series are included. Some of the soils that are well suited to crops and pasture may be in low-intensity use, for example, soils in capability classes I and II. Data in this table can be used to determine the farming potential of such soils.

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

## Woodland management and productivity

Nearly all of Logan County was forest at the time of settlement. The original vegetative types prior to settlement were beech, mixed oak, oak-sugar maple, and elm-ash swamp forest (*5,6*). As a result of clearing, the acreage of woodland has been reduced to about 26,500 acres, or 11 percent of the county. Most of the remaining areas are in small farm woodlots. The steepest, wettest, or least accessible parts of the farms have typically remained wooded. Most of the woodland has been cut over, and much of it has been grazed.

Compared to the returns from the sale of other farm products, income from the sale of wood products is small. Some good-quality logs of red oak, white oak, and black walnut are cut from the better managed woodland. Also, farm woodlots provide wood for fireplaces, lumber for rough construction, maple syrup, and edible nuts.

Table 7 contains information useful to woodland owners or forest managers planning use of soils for wood crops. Map unit symbols for soils suitable for wood crops are listed, and the ordination (woodland suitability) symbol for each soil is given. All soils bearing the same ordination symbol require the same general kinds of woodland management and have about the same potential productivity.

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

In table 7 the soils are also rated for a number of factors to be considered in management. *Slight, moderate,* and *severe* are used to indicate the degree of major soil limitations.

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

special equipment and methods are needed to prevent excessive loss of soil.

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

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

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

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

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

## Engineering

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

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

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

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

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

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

The information is presented mainly in tables. Table 8 shows, for each kind of soil, the degree and kind of limitations for building site development; table 9, for sani-

tary facilities. Table 11 shows the kind of limitations for water management. Table 10 shows the suitability of each kind of soil as a source of construction materials.

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

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

### Building site development

The degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping are indicated in table 8. A *slight* limitation indicates that soil properties generally are favorable for the specified use; any limitation is minor and easily overcome. A *moderate* limitation indicates that soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design. A *severe* limitation indicates that one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required. For some soils rated severe, such costly measures may not be feasible.

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

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

*Dwellings* and *small commercial buildings* referred to in table 8 are built on undisturbed soil and have foundation loads of a dwelling no more than three stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, soils should be sufficiently stable that cracking or subsidence of the structure from settling or shear failure of the foundation does not occur. These ratings were determined from estimates of the shear strength, compressibility, and shrink-swell potential of the soil. Soil texture, plasticity and in-place density, soil wetness, and depth to a seasonal high water table were also considered. Soil wetness and depth to a seasonal high water table indicate potential difficulty in providing adequate drainage for basements, lawns, and gardens. Depth to bedrock, slope, and large stones in or on the soil are also important considerations in the choice of sites for these structures and were considered in determining the ratings. Susceptibility to flooding is a serious hazard.

*Local roads and streets* referred to in table 8 have an all-weather surface that can carry light to medium traffic all year. They consist of a subgrade of the underlying soil material; a base of gravel, crushed rock fragments, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep.

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

*Lawns and landscaping* require soils that are suitable for the establishment and maintenance of turf for lawns and ornamental trees and shrubs for landscaping. The best soils are firm after rains, are not dusty when dry, and absorb water readily and hold sufficient moisture for plant growth. The surface layer should be free of stones. If shaping is required, the soils should be thick enough over bedrock or hardpan to allow for necessary grading. In rating the soils, the availability of water for sprinkling is assumed.

### Sanitary facilities

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons, and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that affect ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table 9 shows the degree and kind of limitations of each soil for such uses and for use of the soil as daily cover for landfills. It is important to observe local ordinances and regulations.

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

about the same as the terms *slight*, *moderate*, and *severe*.

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

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

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

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

*Sewage lagoons* are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons have a nearly level floor and cut slopes or embankments of compacted soil material. Aerobic lagoons generally are designed to hold sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water. Soils that are very high in content of organic matter and those that have cobbles, stones, or boulders are not suitable. Unless the soil has very slow permeability, contamination of ground water is a hazard where the seasonal high water table is above the level of the lagoon floor. In soils where the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce the lagoon's capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the suitability of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soil material affect the performance of embankments.

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

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

Unless otherwise stated, the limitations in table 9 apply only to the soil material within a depth of about 6 feet. If the trench is deeper, a limitation of slight or moderate may not be valid. Site investigation is needed before a site is selected.

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

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

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

### Construction materials

The suitability of each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 10 by ratings of good, fair, or poor. The texture, thickness, and organic-matter content of each soil horizon are important factors in rating soils for use as construction materials. Each soil is evaluated to the depth observed, generally about 6 feet.

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

performance is given in the descriptions of the soil series.

The ratings apply to the soil material between the A horizon and a depth of 5 to 6 feet. It is assumed that soil horizons will be mixed during excavation and spreading. Many soils have horizons of contrasting suitability within their profile. The estimated engineering properties in table 14 provide specific information about the nature of each horizon. This information can help determine the suitability of each horizon for roadfill.

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

*Sand* and *gravel* are used in great quantities in many kinds of construction. The ratings in table 10 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 14.

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

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

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

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

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

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

### Water management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 11 the soil and site features that affect use are indicated for each kind of soil. This information is significant in planning, installing, and maintaining water-control structures.

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

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

*Aquifer-fed excavated ponds* are bodies of water made by excavating a pit or dugout into a ground-water aquifer. Excluded are ponds that are fed by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Ratings in table 11 are for ponds that are properly designed, located, and constructed. Soil properties and site features that affect aquifer-fed ponds are depth to a permanent water table, permeability of the aquifer, quality of the water, and ease of excavation.

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

*Terraces and diversions* are embankments or a combination of channels and ridges constructed across a slope to intercept runoff. They allow water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for terraces are uniformity and steep-

ness of slope; depth to bedrock, hardpan, or other unfavorable material; large stones; permeability; ease of establishing vegetation; and resistance to water erosion, soil blowing, soil slipping, and piping.

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

## Recreation

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

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

The information in table 12 can be supplemented by information in other parts of this survey. Especially helpful are interpretations for septic tank absorption fields, given in table 9, and interpretations for dwellings without basements and for local roads and streets, given in table 8.

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

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

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

*Paths and trails* for walking, horseback riding, bicycling, and other uses should require little or no cutting and filling. The best soils for this use are those that are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once during the annual period of use. They have moderate slopes and have 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 a surface that is free of stones and boulders and have moderate slopes. Suitability of the soil for traps, tees, or greens was not considered in rating the soils. Irrigation is an assumed management practice.

## Wildlife habitat

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

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

In table 13, the soils in the survey area are rated according to their potential to support the main kinds of wildlife habitat in the area. This information can be used in planning for parks, wildlife refuges, nature study areas, and other developments for wildlife; selecting areas that are suitable for wildlife; selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat; and determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor (*1*). A rating of *good* means that the element of wildlife habitat or the kind of habitat is easily created,

improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected if the soil is used for the designated purpose. A rating of *fair* means that the element of wildlife habitat or kind of habitat can be created, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* means that limitations are severe for the designated element or kind of wildlife habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* means that restrictions for the element of wildlife habitat or kind of wildlife are very severe, and that unsatisfactory results can be expected. Wildlife habitat is impractical or even impossible to create, improve, or maintain on soils having such a rating.

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

*Grain and seed crops* are seed-producing annuals used by wildlife. The major soil properties that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

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

*Wild herbaceous plants* are native or naturally established grasses and forbs, including weeds, that provide food and cover for wildlife. Major soil properties that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are foxtail, goldenrod, smartweed, ragweed, and panicum.

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

*Coniferous plants* are cone-bearing trees, shrubs, or ground cover plants that furnish habitat or supply food in the form of browse, seeds, or fruitlike cones. Soil properties that have a major effect on the growth of coniferous plants are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, and cedar.

*Wetland plants* are annual and perennial wild herbaceous plants that grow on moist or wet sites, exclusive of submerged or floating aquatics. They produce food or cover for wildlife that use wetland as habitat. Major soil properties affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, duckweed, willows, and reed canarygrass and rushes, sedges, and reeds.

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

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

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

*Woodland habitat* consists of areas of hardwoods and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

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

## Soil properties

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

In making soil borings during field mapping, soil scientists identify several important soil properties. They note the seasonal soil moisture condition or the presence of free water and its depth. For each horizon in the profile,

they note the thickness and color of the soil material; the texture, or amount of clay, silt, sand, and gravel or other coarse fragments; the structure, or the natural pattern of cracks and pores in the undisturbed soil; and the consistence of the soil material in place under the existing soil moisture conditions. They record the depth of plant roots, determine the pH or reaction of the soil, and identify any free carbonates.

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

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

## Engineering properties

Table 14 gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area.

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Table 14 gives information for each of these contrasting horizons in a typical profile. *Depth* to the upper and lower boundaries of each horizon is indicated. More information about the range in depth and about other properties in each horizon is given for each soil series in the section "Soil series and morphology."

*Texture* is described in table 14 in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use are the Unified Soil Classification System (*3*) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO) (*2*).

The *Unified* system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes—eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example, CL-ML.

The *AASHTO* system classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines. At the other extreme, in group A-7, are fine-grained soils. Highly organic soils are classified in group A-8 on the basis of visual inspection.

When laboratory data are available, the A-1, A-2, and A-7 groups are further classified as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As an additional refinement, the desirability of soils as subgrade material can be indicated by a group index number. These numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The estimated classification, without group index numbers, is given in table 14. Also in table 14 the percentage, by weight, of rock fragments more than 3 inches in diameter is estimated for each major horizon. These estimates are determined mainly by observing volume percentage in the field and then converting that, by formula, to weight percentage.

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

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

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

## Physical and chemical properties

Table 15 shows estimated values for several soil characteristics and features that affect behavior of soils in engineering uses. These estimates are given for each

major horizon, at the depths indicated, in the typical pedon of each soil. The estimates are based on field observations and on test data for these and similar soils.

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

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

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

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

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

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

1. Sands, coarse sands, fine sands, and very fine sands. These soils are extremely erodible, so vegetation is difficult to establish. They are generally not suitable for crops.
2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible, but crops can be grown if intensive measures to control soil blowing are used.
3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible, but crops can be grown if intensive measures to control soil blowing are used.

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

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible, but crops can be grown if measures to control soil blowing are used.
5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible, but crops can be grown if measures to control soil blowing are used.
6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible, and crops can easily be grown.
7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible, and crops can easily be grown.
8. Stony or gravelly soils and other soils not subject to soil blowing.

## Soil and water features

Table 16 contains information helpful in planning land uses and engineering projects that are likely to be affected by soil and water features.

*Hydrologic soil groups* are used to estimate runoff from precipitation. Soils not protected by vegetation are placed in one of four groups on the basis of the intake of water after the soils have been wetted and have received precipitation from long-duration storms.

The four hydrologic soil groups are:

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

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

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

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

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

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

*High water table* is the highest level of a saturated zone more than 6 inches thick for a continuous period of more than 2 weeks during most years. The depth to a seasonal high water table applies to undrained soils. Estimates are based mainly on the relationship between grayish colors or mottles in the soil and the depth to free water observed in many borings made during the course of the soil survey. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table, that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. Only saturated zones above a depth of 5 or 6 feet are indicated.

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

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

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

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

## Physical and chemical analyses of selected soils

Many of the soils in Logan County were sampled and laboratory data determined by the Soil Characterization Laboratory, Department of Agronomy, Ohio State Univer-

sity, Columbus, Ohio. The physical and chemical data obtained on most samples include particle-size distribution, reaction, organic-matter content, calcium carbonate equivalent, and extractable cations.

These data were used in the classification and correlation of the soils and in evaluating the response of the soils to various land uses. Eight of the profiles were selected as representative for their respective series and are described in this survey. These series and their laboratory identification numbers are: Berks (LG-20), Brookston (LG-39), Eldean (LG-35), Fulton (LG-24), Gallman (LG-22), Latty (LG-25), Montgomery (LG-31), and Sleeth (LG-41).

Many of the soils in this county are also in nearby counties in western and central Ohio. Laboratory data collected in these nearby counties and in Logan County are on file at the Department of Agronomy, Ohio State University, Columbus, Ohio; the Ohio Department of Natural Resources, Division of Lands and Soil, Columbus, Ohio; and the Soil Conservation Service, State Office, Columbus, Ohio. Some of these data have been published in special studies of soils in the nearby counties (*9,13*).

## Engineering test data

The results of analyses of engineering properties of several typical soils of the survey area are given in table 17.

The data presented are for soil samples that were collected from carefully selected sites. The soil profiles sampled are typical of the series discussed in the section "Soil series and morphology." The Fulton (LG-24) and Latty (LG-25) samples were analyzed by the Soil Physical Studies Laboratory, Department of Agronomy, Ohio State University. The coarse fragments greater than 2.0 millimeters in diameter were not included in testing. The content of coarse fragments is less than 5 percent, and the deletion does not significantly affect the engineering classification. The Eldean (LG-35), Montgomery (LG-31), and Sleeth (LG-41) samples were analyzed by the Ohio Department of Highways Testing Laboratory.

The methods used in obtaining the data are listed by code in the next paragraph. Most of the codes, in parentheses, refer to the methods assigned by the American Association of State Highway and Transportation Officials. The code for Unified classification is that assigned by the American Society for Testing and Materials.

The methods and codes are AASHTO classification (M-145-66); Unified classification (D-2487-69); mechanical analysis (T88-57); liquid limit (T89-60); plasticity index (T90-56); and moisture-density, method A (T99-57).

# Soil series and morphology

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

Characteristics of the soil and the material in which it formed are discussed for each series. The soil is then compared to similar soils and to nearby soils of other series. Then a pedon, a small three-dimensional area of soil that is typical of the soil series in the survey area, is described. The detailed descriptions of each soil horizon follow standards in the Soil Survey Manual (*10*). Unless otherwise noted, colors described are for moist soil.

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

## Algiers series

The Algiers series consists of deep, somewhat poorly drained, moderately permeable soils formed in recent alluvial material over a buried soil. Slope is 0 to 2 percent.

The Algiers soils in Logan County have a thinner layer of recent alluvium than is defined as the range for the Algiers series. This difference, however, does not alter the use or behavior of the soils.

Algiers soils are commonly adjacent to Sloan soils on flood plains and to Brookston, Pewamo, and Wallkill soils in depressional areas on till plains. Brookston, Pewamo, and Sloan soils have a mollic epipedon. Brookston and Pewamo soils formed in glacial till and Sloan soils in alluvium. Wallkill soils formed in alluvium overlying organic material.

Typical pedon of Algiers silt loam, in Monroe Township, 4 miles northeast of West Liberty, 955 feet southeast of the intersection of Township Road 190 and County Road 5, and 530 feet east of County Road 5:

Ap—0 to 10 inches; dark brown (10YR 4/3) silt loam; moderate fine granular structure; firm; many roots; neutral; abrupt smooth boundary.

C1—10 to 18 inches; dark brown (10YR 4/3) light silty clay loam; weak medium granular structure; firm; many roots; neutral; clear wavy boundary.

IIAb—18 to 30 inches; black (10YR 2/1) silty clay loam; moderate coarse angular blocky structure; firm; common roots; mildly alkaline; clear wavy boundary.

IIB2bg—30 to 42 inches; dark gray (10YR 4/1) silty clay loam; common fine faint grayish brown (10YR 5/2) mottles; moderate coarse angular blocky structure; firm; mildly alkaline; clear wavy boundary.

IIC2g—42 to 60 inches; dark gray (10YR 4/1) silty clay loam; massive; firm; strong effervescence; moderately alkaline.

The solum ranges from 40 to 50 inches in thickness. The medium textured recent alluvium ranges from 16 to 30 inches in thickness.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is slightly acid or neutral. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3. It is light silty clay loam or silt loam. The IIAb horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 0 or 1. It is silty clay loam or clay loam and is slightly acid to mildly alkaline. Mottles with hue of 10YR, value of 3 to 5, and chroma of 1 to 6 are common below a depth of 20 inches. The IIB2bg horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is loam, clay loam, or silty clay loam and is neutral or mildly alkaline. The IIC2g horizon has hue of 10YR to 5Y or is neutral in hue. It has value of 4 or 5 and chroma of 1 to 3.

## Berks series

The Berks series consists of moderately deep, well drained soils formed in material weathered from shale. Permeability is moderate or moderately rapid. Slope ranges from 18 to 50 percent.

The Berks soils in Logan County have a slightly thicker solum and a slightly higher clay content in the subsoil than is defined as the range for the Berks series. These differences, however, do not alter the use or behavior of the soils.

Berks soils are commonly adjacent to Miamian Variant and Weikert soils. The Miamian Variant soils have a higher clay content and base status and a lower content of shale fragments throughout than Berks soils. Weikert soils are shallow to bedrock.

Typical pedon of Berks silt loam, 25 to 50 percent slopes, in Jefferson Township, 2 1/4 miles east-southeast of Zanesfield, 2,640 feet northwest of the intersection of U.S. Route 33 and Township Road 145, and 1,320 feet north of U.S. Route 33:

A1—0 to 2 inches; dark grayish brown (10YR 4/2) silt loam; moderate very fine granular structure; friable; many roots; 5 percent shale fragments; very strongly acid; clear wavy boundary.

A2—2 to 9 inches; light yellowish brown (10YR 6/4) silt loam; moderate fine granular structure; friable; many roots; 10 percent shale fragments; very strongly acid; clear wavy boundary.

B1—9 to 15 inches; brown (10YR 5/3) shaly silt loam; moderate fine subangular blocky structure; firm; common roots; thin patchy brown (7.5YR 5/4) coatings on faces of peds; 20 percent shale fragments; very strongly acid; clear wavy boundary.

B21—15 to 21 inches; brown (10YR 5/3) shaly silty clay loam; moderate medium subangular blocky structure; firm; common roots; thin very patchy strong brown (7.5YR 5/6) clay films on faces of some peds; 40 percent shale fragments; very strongly acid; clear wavy boundary.

B22—21 to 29 inches; brown (7.5YR 5/4) very shaly heavy silt loam; weak medium subangular blocky structure; firm; common roots; thin very patchy clay films on shale fragments; 60 percent shale fragments; interior color of broken shale is dark brown (7.5YR 4/2); very strongly acid; clear wavy boundary.

B3—29 to 39 inches; strong brown (7.5YR 5/6) very shaly heavy loam; weak medium subangular blocky structure; firm; few roots; thin very patchy clay films on shale fragments; 60 percent shale fragments; dark yellowish brown (10YR 3/4) and dark grayish brown (10YR 4/2) shale surfaces; very strongly acid; clear wavy boundary.

Cr—39 to 60 inches; strong brown (7.5YR 5/6) rippable shale bedrock; dark yellowish brown (10YR 3/4) shale interiors; very strongly acid.

The thickness of the solum, or the depth to bedrock, ranges from 20 to 40 inches. The solum is very strongly acid or strongly acid. The upper part of the solum ranges, by volume, from 5 to 20 percent coarse fragments and the lower part from 30 to 60 percent.

The A1 horizon has hue of 10YR, value of 2 to 4, and chroma of 1 to 3. The B2 horizon has hue of 10YR to 5YR, value of 5, and chroma of 3 to 6. It is shaly or very shaly silt loam, loam, or silty clay loam.

## Blount series

The Blount series consists of deep, somewhat poorly drained, slowly or moderately slowly permeable soils formed in calcareous glacial till on ground moraines and end moraines. Slope ranges from 0 to 6 percent.

Blount soils are commonly adjacent to Glynwood, Morley, Pewamo, and Wetzel soils and are similar to Crosby and Nappanee soils. Glynwood and Morley soils are better drained than Blount soils and are not so gray in the subsoil. Pewamo and Wetzel soils are wetter than Blount soils and are more gray in the subsoil. Also, Pewamo soils have a mollic epipedon. Crosby soils contain less clay and Nappanee soils more clay in the B and C horizons than Blount soils.

Typical pedon of Blount silt loam, 2 to 6 percent slopes, in Rush Creek Township, about 2 1/2 miles east of Rushsylvania, 100 feet south of County Road 50, 858 feet west-southwest of the intersection of County Road 50 and Township Road 116:

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam; moderate fine granular structure; friable; common roots; medium acid; abrupt smooth boundary.

B21t—9 to 14 inches; yellowish brown (10YR 5/4) silty clay loam; common fine distinct grayish brown (10YR 5/2) mottles; moderate fine subangular

blocky structure; friable; common roots; thin patchy light brownish gray (10YR 6/2) clay films on faces of peds; medium acid; clear wavy boundary.

B22t—14 to 22 inches; yellowish brown (10YR 5/4) clay; many medium distinct dark gray (10YR 4/1) and common fine faint yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; common roots; ped faces coated dark gray (10YR 4/1); thin patchy clay films on faces of peds; about 2 percent coarse fragments; medium acid; clear wavy boundary.

B23t—22 to 34 inches; dark yellowish brown (10YR 4/4) clay; many medium distinct grayish brown (10YR 5/2) and common medium distinct gray (10YR 6/1) mottles; moderate medium subangular blocky structure; firm; common roots; ped faces coated gray (10YR 6/1); thin patchy gray (10YR 6/1) clay films on faces of peds; 5 percent coarse fragments; neutral; clear wavy boundary.

B3—34 to 40 inches; dark yellowish brown (10YR 4/4) clay loam; many medium distinct grayish brown (10YR 5/2) and common medium distinct dark gray (10YR 4/1) mottles; weak medium subangular blocky structure; firm; common dark gray (10YR 4/1) and grayish brown (10YR 5/2) coatings on faces of peds; 5 percent coarse fragments; strong effervescence; mildly alkaline; clear wavy boundary.

C—40 to 60 inches; yellowish brown (10YR 5/4) clay loam; massive; firm; common gray (10YR 6/1) calcium carbonate accumulations; 5 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 45 inches and the depth to carbonates from 18 to 45 inches. The content of coarse fragments ranges from 0 to 12 percent in the solum and substratum.

The Ap horizon is 7 to 10 inches thick. It has hue of 10YR, value of 4, and chroma of 2 or 3. Unless limed, it ranges from strongly acid to slightly acid. The Bt horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4. It is clay, silty clay, or heavy silty clay loam. It ranges from medium acid in the upper part to neutral in the lower part. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is clay loam or silty clay loam. It is mildly alkaline or moderately alkaline.

## Brookston series

The Brookston series consists of deep, very poorly drained soils formed in calcareous glacial till. These soils are in low lying or depressional areas on ground moraines and end moraines. Permeability is moderate or moderately slow. Slope is 0 to 2 percent.

The Brookston soils in Logan County lack an argillic horizon, which is definitive for the Brookston series. This difference, however, does not alter the use or behavior of the soils.

Brookston soils are commonly adjacent to Algiers, Celina, and Crosby soils and are similar to Pewamo and Wetzel soils. Of these adjacent or similar soils, only the Pewamo soils have a mollic epipedon. Algiers soils formed in recent alluvium and in the underlying buried soil and are somewhat poorly drained. Celina and Crosby soils are less gray in the subsoil than Brookston soils. Pewamo and Wetzel soils contain more clay in the subsoil and substratum than Brookston soils.

Typical pedon of Brookston silty clay loam, in Harrison Township, about 3 1/2 miles west of Bellefontaine, SW1/4NW1/4 sec. 15, R. 14, T. 3, about 20 feet east of section line and 500 feet north of the intersection of County Road 11 and Township Road 201:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silty clay loam; common fine distinct yellowish brown (10YR 5/4) mottles in the lower 3 inches; moderate fine subangular blocky structure; firm; common roots; about 2 percent coarse fragments; neutral; abrupt smooth boundary.

B1t—9 to 14 inches; very dark grayish brown (10YR 3/2) silty clay loam; few fine distinct yellowish brown (10YR 5/4) mottles; moderate fine and medium subangular blocky structure; firm; common roots; thin patchy very dark grayish brown (10YR 3/2) clay films on faces of peds; about 2 percent coarse fragments; neutral; clear wavy boundary.

B21tg—14 to 20 inches; dark grayish brown (2.5Y 4/2) light clay loam; common fine distinct light olive brown (2.5Y 5/4) and many fine distinct yellowish brown (10YR 5/4) mottles; moderate medium angular blocky structure; firm; common roots; thin patchy dark gray (10YR 4/1) clay films; about 2 percent coarse fragments; neutral; clear wavy boundary.

B22tg—20 to 26 inches; gray (10YR 5/1) silty clay loam; common fine faint light brownish gray (2.5Y 6/2) and many fine distinct light olive brown (2.5Y 5/4) mottles; moderate medium angular blocky structure; firm; common roots; thin patchy gray (10YR 5/1) and dark gray (10YR 4/1) clay films on faces of peds; about 2 percent coarse fragments; neutral; clear wavy boundary.

B23tg—26 to 31 inches; grayish brown (10YR 5/2) silt loam; many fine distinct light brownish gray (2.5Y 6/2) and gray (10YR 6/1) mottles; moderate medium angular blocky structure; firm; common roots; thin patchy gray (10YR 5/1) clay films on faces of peds; about 4 percent coarse fragments; mildly alkaline; clear wavy boundary.

B3—31 to 36 inches; yellowish brown (10YR 5/4) silt loam; many fine distinct gray (10YR 6/1) mottles; weak coarse angular blocky structure; firm; common roots; thin very patchy gray (10YR 6/1) clay films on faces of peds; 10 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C1—36 to 42 inches; yellowish brown (10YR 5/4) loam; many fine distinct gray (10YR 6/1) mottles; weak coarse angular blocky structure; firm; gray (10YR 6/1) coatings on vertical partings; 10 percent coarse fragments; strong effervescence; moderately alkaline; clear wavy boundary.

C2—42 to 55 inches; yellowish brown (10YR 5/4) loam; common fine distinct gray (10YR 6/1) mottles; massive; firm; common gray (10YR 6/1) coatings on vertical partings; 10 percent coarse fragments; strong effervescence; moderately alkaline; clear wavy boundary.

C3—55 to 60 inches; yellowish brown (10YR 5/4) loam; massive; firm; gray (10YR 6/1) coatings on vertical partings; 10 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 30 to 45 inches and the depth to carbonates from 20 to 50 inches. The upper part of the solum is slightly acid or neutral, and the lower part is neutral or mildly alkaline. The content of coarse fragments ranges, by volume, from 2 to 12 percent throughout the soil. The mollic epipedon is 10 to 16 inches thick.

The Ap and B1 horizons have hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The B2 horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. The C horizon is dominantly loam or silt loam.

## Carlisle series

The Carlisle series consists of deep, very poorly drained soils formed in organic deposits derived from grasses, sedges, reeds, and woody material. These soils occupy bogs in morainic areas and on outwash plains. Permeability ranges from moderately slow to moderately rapid. Slope is 0 to 2 percent.

Carlisle soils are commonly adjacent to the Edwards, Martisco, Muskego, and Wallkill soils. Edwards, Martisco, and Muskego soils formed in a thinner organic deposit. Wallkill soils have a mineral surface layer.

Typical pedon of Carlisle muck, in Jefferson Township, about 4 1/2 miles northeast of Bellefontaine, 2,705 feet east of County Road 25, and 4,225 feet southeast of the intersection of County Road 25 and State Route 47:

Oa1—0 to 9 inches; black (10YR 2/1) sapric material; 15 percent fiber, 5 percent rubbed; moderate fine granular structure; very friable; common roots; mildly alkaline; clear smooth boundary.

Oa2—9 to 15 inches; black (10YR 2/1) sapric material; 20 percent fiber, 5 percent rubbed; moderate medium angular blocky structure; friable; common roots; neutral; clear wavy boundary.

Oa3—15 to 23 inches; black (10YR 2/1) sapric material; 20 percent fiber;, 5 percent rubbed; moderate medium angular blocky structure; friable; neutral; abrupt smooth boundary.

Oa4—23 to 29 inches; dark brown (10YR 3/3) sapric material; 40 percent fiber, 10 percent rubbed; moderate medium angular blocky structure; friable; neutral; abrupt smooth boundary.

Oa5—29 to 38 inches; black (10YR 2/1) sapric material; 5 percent fiber, none rubbed; massive; friable; mildly alkaline; abrupt smooth boundary.

Oa6—38 to 45 inches; very dark brown (10YR 2/2) sapric material; 10 percent fiber, none rubbed; massive; friable; mildly alkaline; abrupt smooth boundary.

Oa7—45 to 50 inches; very dark brown (10YR 2/2) sapric material; 40 percent fiber, less than 10 percent rubbed; massive; friable; mildly alkaline; abrupt smooth boundary.

Oa8—50 to 55 inches; very dark gray (10YR 3/1) sapric material; 40 percent fiber, less than 10 percent rubbed; massive; friable; mildly alkaline; abrupt smooth boundary.

Oe9—55 to 60 inches; very dark grayish brown (10YR 3/2) hemic material; 50 percent fiber, more than 16 percent rubbed; massive; friable; mildly alkaline.

The organic material is commonly more than 60 inches thick, but in some areas mineral or coprogenous material is as shallow as 51 inches. The subsurface tier ranges from medium acid to mildly alkaline. The surface and subsurface tiers have hue of 10YR or 7.5YR or are neutral in hue. They have value of 2 or 3 and chroma of 1 or 2. The fiber content in the subsurface tier ranges from 5 to 40 percent before rubbing and is less than 10 percent after rubbing. The bottom tier is dominantly sapric material but has thin layers of hemic material in some pedons.

## Casco series

The Casco series consists of deep, somewhat excessively drained soils formed in glacial outwash on kames and outwash terraces. Permeability is moderate in the subsoil and very rapid in the substratum. Slope ranges from 12 to 50 percent.

Casco soils are commonly adjacent to Eldean and Rodman soils and are similar to Fox soils. Eldean and Fox soils have a thicker solum than Casco soils. Also, Eldean soils have a higher content of clay in the subsoil. Rodman soils have a thinner solum than Casco soils, do not have an argillic horizon, and have a mollic epipedon.

Typical pedon of Casco gravelly loam, in an area of Casco-Eldean complex, 12 to 18 percent slopes, moderately eroded, in Monroe Township, about 1 mile northeast of West Liberty, NE1/4SE1/4 sec. 22, R. 13, T. 5, about 80 feet south of County Road 43 and 2,475 feet east of the Monroe-Liberty Township line:

Ap—0 to 5 inches; dark brown (10YR 4/3) gravelly loam; moderate medium granular structure; friable; many roots; 20 percent coarse fragments; neutral; abrupt smooth boundary.

B21t—5 to 9 inches; dark brown (10YR 4/3) gravelly loam; moderate medium granular structure; friable; many roots; ped faces coated very dark grayish brown (10YR 3/2); thin patchy clay films on faces of peds; 25 percent coarse fragments; neutral; clear wavy boundary.

B22t—9 to 16 inches; dark yellowish brown (10YR 4/4) gravelly clay loam; moderate medium subangular blocky structure; friable; many roots; thin patchy dark brown (7.5YR 3/2) clay films on faces of peds and coating gravel; 25 percent coarse fragments; neutral; clear irregular boundary.

B3—16 to 19 inches; dark yellowish brown (10YR 4/4) gravelly sandy loam; weak fine subangular blocky structure; friable; many roots; 25 percent coarse fragments; slight effervescence; mildly alkaline; clear irregular boundary.

C—19 to 60 inches; yellowish brown (10YR 5/4) very gravelly sand; single grained; loose; 55 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 10 to 24 inches. The content of coarse fragments ranges from 15 to 25 percent in the solum.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. The B2t horizon has hue of 10YR or 7.5YR and value and chroma of 3 or 4.

## Celina series

The Celina series consists of deep, moderately well drained, moderately slowly permeable soils. These soils formed in calcareous glacial till capped by a thin layer of loess on ground moraines and end moraines. Slope ranges from 0 to 6 percent.

Celina soils are commonly adjacent to Brookston, Crosby, and Miamian soils and are similar to Glynwood and St. Clair soils. Brookston and Crosby soils are in depressions and on broad flats and slight rises. They are more gray in the subsoil than Celina soils. Also, Brookston soils have a mollic epipedon. Miamian soils are on knolls, side slopes, and ridges. They do not have low chroma mottles in the upper part of the argillic horizon. Celina soils and Glynwood and St. Clair soils are in similar positions on the landscape, but Glynwood and St. Clair soils contain more clay in the subsoil and substratum and are of illitic mineralogy.

Typical pedon of Celina silt loam, 2 to 6 percent slopes, in Zane Township, about 3 1/2 miles south of Middleburg, 4,160 feet southeast of the intersection of County Road 44 and Township Road 160, and 3,170 feet east of Township Road 160:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; moderate fine granular structure; friable; many roots; slightly acid; abrupt smooth boundary.

B21t—8 to 11 inches; yellowish brown (10YR 5/4) silty clay loam; moderate fine subangular blocky structure; firm; many roots; thin patchy brown (10YR 5/3) clay films on faces of peds; strongly acid; clear wavy boundary.

B22t—11 to 19 inches; yellowish brown (10YR 5/4) clay; few fine faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; common roots; thin patchy yellowish brown (10YR 5/6) clay films on faces of peds; 10 percent coarse fragments; medium acid; clear wavy boundary.

B3t—19 to 23 inches; yellowish brown (10YR 5/4) heavy clay loam; common fine faint grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few roots; thin patchy clay films on faces of peds; few fine black (10YR 2/1) stains; 10 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C1—23 to 29 inches; yellowish brown (10YR 5/4) loam; common fine faint grayish brown (10YR 5/2) mottles; massive; firm; thin very patchy clay films in pores in the upper part; few fine black (10YR 2/1) stains; about 12 percent coarse fragments; strong effervescence; moderately alkaline; clear wavy boundary.

C2—29 to 60 inches; yellowish brown (10YR 5/4) loam; massive; firm; few light gray (10YR 6/1) streaks; about 12 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 22 to 38 inches and the depth to carbonates from 18 to 28 inches. The content of coarse fragments ranges from 0 to 10 percent in the A horizon and the upper part of the B horizon and from 5 to 15 percent in the lower part of the B horizon and in the C horizon.

The A horizon is medium acid to neutral. The B2 horizon has hue of 10YR, value of 4 or 5, and chroma of 4. It is clay, clay loam, or silty clay loam. Reaction ranges from strongly acid to neutral in the upper part of the B horizon and from slightly acid to mildly alkaline in the lower part.

## Crosby series

The Crosby series consists of deep, somewhat poorly drained, slowly permeable soils formed in calcareous glacial till on ground moraines and end moraines. Slope ranges from 0 to 6 percent.

Crosby soils are commonly adjacent to Brookston, Celina, and Miamian soils and are similar to Blount and Nappanee soils. Brookston soils are in depressional areas. They have a mollic epipedon. Celina and Miamian soils are less gray in the solum than Crosby soils. They are on low knolls, ridgetops, and hillsides. Blount and Nappanee soils are of illitic mineralogy and contain more clay in the subsoil and substratum than Crosby soils.

Typical pedon of Crosby silt loam, 2 to 6 percent slopes, in Zane Township, about 4 1/2 miles south-southeast of Middleburg, 925 feet west of State Route 559, and 825 feet west of the intersection of State Route 559 and Township Road 258:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; moderate fine granular structure; friable; common roots; 5 percent gravel; neutral; abrupt smooth boundary.

B1—8 to 12 inches; yellowish brown (10YR 5/4) silty clay loam; common fine distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; common roots; common dark grayish brown (10YR 4/2) coatings on faces of peds; 5 percent gravel; neutral; clear wavy boundary.

B21t—12 to 20 inches; dark yellowish brown (10YR 4/4) light clay; many fine distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; common roots; ped faces coated grayish brown (10YR 5/2); thin patchy clay films on faces of peds; 10 percent gravel; neutral; clear wavy boundary.

B22t—20 to 23 inches; dark yellowish brown (10YR 4/4) light clay; many fine distinct grayish brown (10YR 5/2) and common fine distinct dark gray (10YR 4/1) mottles; moderate medium subangular blocky structure; firm; common roots; ped faces coated grayish brown (10YR 5/2); thin patchy clay films on faces of peds; 10 percent gravel; mildly alkaline; clear wavy boundary.

B3—23 to 30 inches; yellowish brown (10YR 5/4) heavy loam; common fine distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm; thin very patchy grayish brown (10YR 5/2) clay films; 10 percent gravel; slight effervescence; mildly alkaline; clear wavy boundary.

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

The thickness of the solum ranges from 22 to 36 inches and the depth to carbonates from 20 to 36 inches. The content of gravel ranges from 5 to 15 percent throughout the soil.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The B2t horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 5. It is heavy clay loam or clay. It is dominantly neutral or slightly acid, but the lower part is mildly alkaline in some pedons.

## Del Rey series

The Del Rey series consists of deep, somewhat poorly drained, slowly permeable soils formed in calcareous lacustrine sediments that have a high content of silt. These soils are on broad flats in the basins of former glacial lakes. Slope ranges from 0 to 6 percent.

The Del Rey soils in Logan County have a thinner B2 horizon than is defined as the range for the Del Rey series. This difference, however, does not alter the use or behavior of the soils.

Del Rey soils are commonly adjacent to Crosby, Montgomery, and Shinrock soils and are similar to Fulton and Henshaw soils. Crosby soils formed in glacial till on till plains. Fulton soils contain more clay in the subsoil than Del Rey soils and Henshaw soils contain less. Montgomery soils are in flat or depressional areas. They have a mollic epipedon. Shinrock soils, which are along drainageways and on convex knolls and ridgetops, are better drained than Del Rey soils.

Typical pedon of Del Rey silt loam, 0 to 2 percent slopes, in Pleasant Township, NE1/4SE1/4 sec. 32, R. 14, T. 3, about 2 miles northeast of DeGraff, 2,510 feet northwest of the intersection of County Road 43 and Township Road 33, and 1,520 feet west of Township Road 33:

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam; moderate fine granular structure; many roots; friable; 5 percent gravel; slightly acid; abrupt smooth boundary.

B21t—7 to 13 inches; brown (10YR 4/3) light silty clay; many fine faint dark grayish brown (10YR 4/2) mottles; moderate medium prismatic structure parting to moderate medium blocky; firm; common roots; ped faces coated dark grayish brown (2.5Y 4/2); thin patchy clay films on faces of peds; slightly acid; clear wavy boundary.

B22t—13 to 18 inches; brown (10YR 4/3) silty clay; many fine faint brown (10YR 5/3) and grayish brown (2.5Y 5/2) mottles; moderate medium prismatic structure parting to moderate medium blocky; firm; common roots; ped faces coated dark grayish brown (10YR 4/2); thin patchy grayish brown (2.5Y 5/2) clay films on faces of peds; mildly alkaline; clear wavy boundary.

B3—18 to 29 inches; dark yellowish brown (10YR 4/4) light silty clay loam; weak medium prismatic structure parting to weak medium blocky; common roots; firm; ped faces coated gray (10YR 6/1); slight effervescence; mildly alkaline; clear wavy boundary.

C1—29 to 36 inches; dark yellowish brown (10YR 4/4) silty clay loam; massive; firm; gray (10YR 6/1) calcium carbonate accumulations in vertical partings; strong effervescence; moderately alkaline; clear wavy boundary.

C2—36 to 48 inches; yellowish brown (10YR 5/4) silty clay loam; massive; firm; gray (10YR 6/1) calcium carbonate accumulations in vertical partings; strong effervescence; moderately alkaline; clear wavy boundary.

C3—48 to 60 inches; yellowish brown (10YR 5/4) silty clay loam; massive; firm; grayish brown (10YR 5/2) calcium carbonate accumulations in vertical partings; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 26 to 40 inches and the depth to carbonates from 13 to 21 inches. The solum generally contains no gravel, but the Ap horizon can be, by volume, as much as 5 percent gravel.

The B2t horizon has hue of 10YR, value of 4 to 6, and chroma of 3 or 4. It is heavy silty clay loam or silty clay. The C horizon is either unstratified silt loam or silty clay loam or stratified silt loam, silty clay loam, or silty clay.

## Edwards series

The Edwards series consists of deep, very poorly drained soils formed in organic material 16 to 45 inches deep over marl. These soils are in depressions in outwash plains, lake plains, and till plains. Permeability is moderately rapid to moderately slow in the organic material. Slope is 0 to 2 percent.

Edwards soils are commonly adjacent to Carlisle, Linwood, Martisco, Muskego, and Willette soils and are similar to Martisco soils. Carlisle soils formed in more than 51 inches of accumulated organic material. Linwood soils are underlain with loamy material and Willette soils with clayey or silty material. Martisco soils formed in organic deposits that are shallower over marl than those in which Edwards soils formed. Muskego soils formed in organic deposits over sedimentary peat.

Typical pedon of Edwards muck, in Harrison Township, about 3 miles southwest of Bellefontaine, SE1/4NE1/4 sec. 15, R. 14, T. 3, about 3,550 feet west-southwest of the intersection of County Road 11 and Township Road 198 and 1,055 feet east of County Road 11:

Oa1—0 to 16 inches; black (N 2/0) broken face and rubbed sapric material; about 10 percent fiber, less than 5 percent rubbed; moderate fine granular structure; friable; many roots; few shell fragments; mildly alkaline; clear smooth boundary.

Oa2—16 to 26 inches; black (N 2/0) broken face and rubbed sapric material; about 20 percent fiber, less than 5 percent rubbed; moderate medium subangular blocky structure; friable; common roots; common shells; mildly alkaline; clear smooth boundary.

Lca1—26 to 34 inches; white (10YR 8/1) marl; common medium distinct yellowish brown (10YR 5/6) mottles; massive; friable; common roots; common dark gray (10YR 4/1) and yellowish brown (10YR 5/4) root channels; violent effervescence; moderately alkaline; clear wavy boundary.

Lca2—34 to 46 inches; white (10YR 8/2) marl; common medium distinct light olive brown (2.5Y 5/4) mottles; massive; friable; few roots; dark gray (10YR 4/1) and yellowish brown (10YR 5/6) root channels; violent effervescence; moderately alkaline; clear wavy boundary.

Lca3—46 to 60 inches; light gray (10YR 7/1) marl; massive; friable; common yellowish brown (10YR 5/6) root channels; violent effervescence; moderately alkaline.

Depth to the Lca horizon ranges from 16 to 45 inches. The fiber is derived from herbaceous plants. Thin layers of hemic material are in some pedons. The combined thickness of the layers of this material between the subsurface tier and the bottom tiers is less than 10 inches thick. The organic material ranges from medium acid to mildly alkaline.

The surface tier has hue of 10YR, or has neutral hue, and has value of 2, and chroma of 0 to 2, broken face and rubbed. The organic part of the subsurface and bottom tiers has hue of 10YR to 5YR, or has neutral hue, and has value of 2 or 3, and chroma of 0 to 3, broken face and rubbed. The Lca horizon has hue of 10YR, value of 5 to 8, and chroma of 1 or 2.

## Eel series

The Eel series consists of deep, moderately well drained, moderately permeable soils formed in alluvium on bottom land. Slope is 0 to 2 percent.

The Eel soils in Logan County have more strongly developed structure in the subsoil than is defined as the range for the Eel series. This difference, however, does not alter the use or behavior of the soils.

Eel soils are commonly adjacent to Genesee, Shoals, and Sloan soils. Genesee soils, which are on the highest parts of the flood plain, are better drained than Eel soils. Shoals and Sloan soils, which are on the lower parts of the flood plain, are wetter than Eel soils. Also, Sloan soils have a mollic epipedon.

Typical pedon of Eel silt loam, in Rush Creek Township, about 3 miles northeast of Rushsylvania, 5,180 feet south-southwest of the intersection of County Road 12 and Township Road 116, and 760 feet east of Township Road 116:

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam; weak fine and medium subangular blocky structure; friable; many roots; mildly alkaline; abrupt smooth boundary.

B1—9 to 13 inches; dark brown (10YR 4/3) silt loam; weak medium subangular blocky structure; friable; common roots; thin patchy very dark grayish brown (10YR 3/2) coatings on faces of peds; mildly alkaline; clear wavy boundary.

B21—13 to 18 inches; dark brown (10YR 4/3) silt loam; common fine faint dark grayish brown (10YR 4/2) mottles; moderate medium subangular blocky structure; friable; common roots; mildly alkaline; clear wavy boundary.

B22—18 to 25 inches; brown (10YR 4/3) silty clay loam; many fine faint dark grayish brown (10YR 4/2) mottles; moderate fine subangular blocky structure; firm; common roots; mildly alkaline; clear wavy boundary.

B23—25 to 31 inches; dark yellowish brown (10YR 4/4) silty clay loam; many fine faint dark grayish brown (10YR 4/2) and common medium faint dark yellowish brown (10YR 3/4) mottles; moderate medium subangular blocky structure; firm; common roots; mildly alkaline; clear wavy boundary.

B3—31 to 38 inches; yellowish brown (10YR 5/4) silty clay loam; many fine distinct dark grayish brown (10YR 4/2) and common medium faint dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; firm; common roots; mildly alkaline; clear wavy boundary.

C1—38 to 44 inches; brown (10YR 5/3) silty clay loam; massive; firm; dark grayish brown (10YR 4/2) coatings in partings; slight effervescence; moderately alkaline; clear wavy boundary.

C2—44 to 49 inches; dark grayish brown (10YR 4/2) silty clay loam; massive; firm; slight effervescence; moderately alkaline; clear wavy boundary.

C3—49 to 65 inches; brown (10YR 5/3) silty clay loam; massive; firm; slight effervescence; moderately alkaline.

The depth to free carbonates commonly ranges from 24 to 40 inches. Reaction is neutral to moderately alkaline throughout the soil.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The B horizon has hue of 10YR, value of 4 to 6, and chroma of 2 to 4. It is silt loam, loam, light silty clay loam, or clay loam. Below a depth of 40 inches, the C horizon has strata of loam, silt loam, silty clay loam, or fine sand.

## Eldean series

The Eldean series consists of deep, well drained soils formed in glacial outwash on terraces, kames, and moraines. Permeability is moderate or moderately slow in the subsoil and rapid or very rapid in the substratum. Slope ranges from 0 to 18 percent.

Eldean soils are commonly adjacent to the Casco, Fox, Nineveh, Ockley, and Rodman soils and the Wea Variant and are similar to Fox soils. Casco and Rodman soils are on valley sides and short slope breaks. They have a thinner solum than Eldean soils. Eldean soils and Fox and Ockley soils are in similar positions on the landscape, but Fox and Ockley soils contain less clay in the subsoil. Also, Ockley soils have a thicker solum. Nineveh soils and the Wea Variant are slightly lower on the landscape than Eldean soils, have a mollic epipedon, and contain less clay in the subsoil.

Typical pedon of Eldean silt loam, 0 to 2 percent slopes, in Monroe Township, about 1 1/2 miles southwest of Pickerelltown, 400 feet east of Township Road 178, and 2,110 feet southwest of the intersection of County Road 47 and Township Road 178:

Ap—0 to 7 inches; dark brown (10YR 4/3) silt loam; moderate fine granular structure; friable; common roots; 5 percent gravel; neutral; abrupt smooth boundary.

B21t—7 to 12 inches; dark brown (7.5YR 4/4) clay; moderate fine and medium subangular blocky structure; firm; common roots; thin patchy dark yellowish brown (10YR 4/4) clay films on faces of peds; 5 percent gravel; slightly acid; clear wavy boundary.

B22t—12 to 17 inches; brown (7.5YR 4/4) heavy clay loam; moderate medium subangular blocky structure; firm; common roots; thin patchy dark brown (10YR 3/3) clay films on faces of peds; 10 percent gravel; common black (10YR 2/1) stains; slightly acid; clear wavy boundary.

B23t—17 to 23 inches; brown (7.5YR 4/4) gravelly sandy clay; moderate medium subangular blocky structure; firm; common roots; thin patchy dark brown (10YR 3/3) and (7.5YR 4/2) clay films on faces of peds and coating gravel; common black (10YR 2/1) stains; 15 percent gravel; medium acid; clear wavy boundary.

B31t—23 to 28 inches; brown (10YR 4/3) gravelly clay loam; weak medium subangular blocky structure; firm; common roots; thin patchy dark brown (10YR 3/3) clay films on gravel; common brown (10YR 5/3) weathered limestone fragments; 25 percent gravel; neutral; clear wavy boundary.

B32—28 to 34 inches; brown (10YR 5/3) gravelly coarse sandy loam; weak medium subangular blocky structure; loose; few roots; 30 percent gravel; slight effervescence; mildly alkaline; clear wavy boundary.

C—34 to 60 inches; brown (10YR 5/3) gravelly sand; loose; single grained; 30 percent gravel; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 40 inches and the depth to carbonates from 18 to 31 inches. The upper part of the solum is medium acid to neutral and the lower part neutral or mildly alkaline. The content of gravel ranges, by volume, from 0 to 30 percent in the A horizon and the upper part of the B2 horizon and from 10 to 60 percent in the lower part of the B2 horizon and in the B3 horizon.

The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. It is dominantly silt loam, but in some pedons it is loam. The B2t horizon has hue of 10YR to 5YR, value of 3 to 5, and chroma of 2 to 6. It is clay, sandy clay, or clay loam or the gravelly analogs of these textures. The B3 horizon has hue of 10YR to 5YR, value of 3 to 6, and chroma of 2 or 3. It is gravelly clay loam, gravelly coarse sandy loam, or gravelly loam. The C horizon has hue of 10YR, value of 4 to 6, and chroma of 2 to 4.

## Fox series

The Fox series consists of deep, well drained soils formed in glacial outwash on terraces. Permeability is moderate in the solum and very rapid in the substratum. Slope ranges from 0 to 6 percent.

Fox soils are commonly adjacent to Casco, Eldean, and Ockley soils and are similar to Eldean soils. Casco soils are in the more hilly areas. They have a thinner solum than Fox soils. Ockley soils have a thicker solum, and Eldean soils contain more clay in the subsoil.

Typical pedon of Fox loam, 2 to 6 percent slopes, in Richland Township, about 1 mile southwest of Belle Center, 690 feet west of County Road 39, and 5,655 feet southwest of the intersection of State Routes 273 and 638:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam; moderate very fine granular structure; friable; many roots; 10 percent gravel; slightly acid; abrupt smooth boundary.

B21t—8 to 12 inches; brown (10YR 4/3) loam; moderate fine subangular blocky structure; friable; common roots; thin patchy clay films on faces of peds; 10 percent gravel; slightly acid; clear wavy boundary.

B22t—12 to 24 inches; dark yellowish brown (10YR 4/4) sandy clay loam; moderate medium subangular blocky structure; firm; common roots; thin patchy brown (7.5YR 4/4) clay films on faces of peds; 10 percent gravel; slightly acid; clear wavy boundary.

B23t—24 to 32 inches; dark brown (7.5YR 4/4) gravelly clay loam; moderate medium subangular blocky structure; firm; common roots; thin patchy clay films on faces of peds and coating gravel; common black (10YR 2/1) stains; 25 percent gravel; mildly alkaline; clear wavy boundary.

B3—32 to 36 inches; yellowish brown (10YR 5/4) gravelly sandy loam; weak medium subangular blocky structure; friable; 25 percent gravel; slight effervescence; mildly alkaline; clear wavy boundary.

C—36 to 60 inches; brown (10YR 5/3) gravelly sand; single grained; loose; 20 percent gravel; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 36 inches and the depth to calcareous material from 20 to 32 inches. The upper part of the solum is slightly acid or neutral and the lower part neutral or mildly alkaline. The gravel content ranges from 0 to 10 percent in the upper part of the B2 horizon and from 10 to 25 percent in the lower part and in the B3 horizon.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The B2t horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 3 to 5. It is loam, clay loam, silty clay loam, or sandy clay loam or the gravelly analogs of these textures.

## Fulton series

The Fulton series consists of deep, somewhat poorly drained soils formed in lake-laid sediments on lake plains. Permeability is slow or very slow. Slope ranges from 0 to 4 percent.

Fulton soils are commonly adjacent to Latty soils and are similar to Del Rey soils. Latty soils, which are on flats and in shallow depressions, are wetter than Fulton soils. Del Rey soils contain less clay in the subsoil than Fulton soils.

Typical pedon of Fulton silt loam, 0 to 4 percent slopes, in Stokes Township, NW1/4NW1/4 sec. 2, T. 7 S., R. 8 E., 1 mile west of Russells Point, 890 feet southeast of the intersection of State Route 235 and Township Road 52, and 280 feet south of Township Road 52:

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam; moderate fine granular structure; friable; many roots; about 1 percent gravel; medium acid; abrupt smooth boundary.

B21t—7 to 14 inches; dark yellowish brown (10YR 4/4) silty clay; many medium faint dark grayish brown (10YR 4/2) and dark brown (10YR 4/3) mottles; moderate fine subangular blocky structure; firm; common roots; ped faces coated dark grayish brown (10YR 4/2); thin patchy clay films on faces of peds; medium acid; clear wavy boundary.

B22t—14 to 20 inches; yellowish brown (10YR 5/4) silty clay; many medium distinct dark grayish brown (10YR 4/2) and many medium faint light olive brown (2.5Y 5/4) mottles; moderate medium prismatic structure parting to moderate medium angular blocky; firm; common roots; ped faces coated dark gray (10YR 4/1) and dark grayish brown (10YR 4/2); thin patchy clay films on faces of peds; neutral; clear wavy boundary.

B23t—20 to 29 inches; yellowish brown (10YR 5/4) silty clay; many medium distinct dark grayish brown (10YR 4/2) and gray (10YR 5/1) mottles; moderate medium prismatic structure parting to moderate coarse angular blocky; firm; common roots; ped faces coated grayish brown (10YR 5/2); thin patchy clay films on faces of peds; thin patchy black (10YR 2/1) stains; mildly alkaline; clear wavy boundary.

B3t—29 to 41 inches; yellowish brown (10YR 5/4) silty clay; weak coarse prismatic structure parting to weak coarse angular blocky; firm; ped faces coated gray (10YR 5/1); thin patchy clay films on faces of peds; slight effervescence; mildly alkaline; clear wavy boundary.

C—41 to 60 inches; yellowish brown (10YR 5/4) clay; massive; firm; gray (10YR 6/1) coatings on pressure faces; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 28 to 45 inches and the depth to carbonates from 24 to 42

inches. Reaction is neutral to strongly acid in the A horizon and the upper part of the B horizon and slightly acid to mildly alkaline in the lower part. The B and C horizons have no coarse fragments, but in some pedons the A horizon is as much as 2 percent coarse fragments.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2. The B2 horizon has hue of 10YR, value of 4 or 5, and chroma of 1 to 4. It is dominantly silty clay or clay, but it has thin strata of silty clay loam in some pedons. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is dominantly clay or silty clay, but it has thin layers of loamy material in some pedons.

## Gallman series

The Gallman series consists of deep, well drained soils formed in poorly sorted glacial material on outwash plains. Permeability is moderately rapid. Slope ranges from 1 to 4 percent.

Gallman soils commonly are near Eldean, Fox, Nineveh, and Ockley soils and the Wea Variant and are similar to Eldean, Fox, and Ockley soils. Eldean, Fox, Nineveh, and Ockley soils have a thinner solum than Gallman soils. Also, Eldean soils contain more clay in the subsoil. Nineveh soils and the Wea Variant have a mollic epipedon.

Typical pedon of Gallman loam, 1 to 4 percent slopes, in Jefferson Township, about 2 miles southeast of Zanesfield, 2,030 feet south of the intersection of U.S. Route 33 and County Road 153, and 3,030 feet southeast of the intersection of U.S. Route 33 and County Road 28:

Ap—0 to 8 inches; brown (10YR 4/3) loam; moderate fine granular structure; friable; many roots; 5 percent shale fragments; medium acid; abrupt smooth boundary.

B1—8 to 17 inches; brown (10YR 4/3) loam; moderate fine subangular blocky structure; friable; many roots; thin patchy very dark grayish brown (10YR 3/2) coatings on faces of peds; 5 percent gravel; strongly acid; clear wavy boundary.

B21t—17 to 26 inches; brown (7.5YR 4/3) loam; moderate medium subangular blocky structure; firm; common roots; thin dark brown (7.5YR 4/3) coatings on faces of peds; thin very patchy clay films on faces of peds; 10 percent shale; slightly acid; clear wavy boundary.

B22t—26 to 31 inches; brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; common roots; thin patchy dark brown (7.5YR 4/3) clay films on faces of peds; 10 percent shale; slightly acid; clear wavy boundary.

B23t—31 to 38 inches; brown (7.5YR 4/4) shaly clay loam; moderate medium subangular blocky structure; firm; common roots; medium patchy dark brown (7.5YR 4/3) clay films on faces of peds; 15 percent shale; medium acid; clear wavy boundary.

IIB24t—38 to 53 inches; dark yellowish brown (10YR 3/4) shaly clay loam; moderate medium subangular blocky structure; firm; few roots; thin patchy clay films coating gravel; 30 percent coarse fragments; neutral; clear wavy boundary.

IIIB3t—53 to 75 inches; brown (10YR 5/3) gravelly loam; weak medium subangular blocky structure; friable; thin patchy clay films coating gravel; 40 percent gravel; slight effervescence; mildly alkaline.

Reaction ranges from neutral to medium acid in the A horizon, from very strongly acid to neutral in the upper part of the B horizon, and from slightly acid to mildly alkaline in the lower part. The content of coarse fragments ranges from 5 to 30 percent in the B2 horizon and from 15 to 40 percent in the B3 and C horizons.

The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. The B2t horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 3 or 4. It is clay loam or loam or the gravelly or shaly analogs of these textures. The B3 horizon has hue of 10YR, value of 3 to 5, and chroma of 3 or 4. It is shaly or gravelly loam or clay loam.

## Genesee series

The Genesee series consists of deep, well drained, moderately permeable soils formed in alluvium on bottom land. Slope is 0 to 2 percent.

Genesee soils are associated with Eel, Shoals, and Sloan soils. All of these associated soils are wetter than Genesee soils and have mottles with chroma of 2 or less within a depth of 20 inches. Also, Sloan soils have a mollic epipedon.

Typical pedon of Genesee silt loam, in Perry Township, about 2 miles south of West Mansfield, 4,950 feet northwest of the intersection of County Roads 2 and 142, and 2,180 feet north of County Road 2:

Ap—0 to 10 inches; dark brown (10YR 4/3) silt loam; moderate fine granular structure; friable; many roots; mildly alkaline; abrupt smooth boundary.

C1—10 to 18 inches; brown (10YR 4/3) silt loam; weak fine subangular blocky structure; friable; common roots; mildly alkaline; clear wavy boundary.

C2—18 to 34 inches; dark yellowish brown (10YR 4/4) silt loam; weak fine subangular blocky structure; friable; few roots; mildly alkaline; clear wavy boundary.

C3—34 to 50 inches; brown (10YR 4/3) silt loam; weak fine granular structure; friable; strong effervescence; moderately alkaline; clear wavy boundary.

C4—50 to 60 inches; brown (10YR 4/3) silt loam; massive; friable; strong effervescence; moderately alkaline.

The depth to free carbonates ranges from 24 to 40 inches. Reaction is mildly alkaline or moderately alkaline throughout the soil.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. To a depth of about 40 inches, the C horizon typically has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is typically silt loam, but it has thin layers of loam and silty clay loam in some pedons.

## Glynwood series

The Glynwood series consists of deep, moderately well drained, slowly permeable soils. These soils formed in calcareous glacial till on ground moraines and end moraines. Slope ranges from 2 to 6 percent.

Glynwood soils are commonly adjacent to Blount and Morley soils and are similar to Celina and St. Clair soils. Blount soils are wetter than Glynwood soils and have a grayer subsoil. Morley soils are better drained than Glynwood soils and have a less gray subsoil. Celina soils contain less clay and St. Clair soils more clay in the B and C horizons than Glynwood soils.

Typical pedon of Glynwood silt loam, 2 to 6 percent slopes, in Rush Creek Township, about 2 miles northeast of Rushsylvania, 2,440 feet east-northeast of the intersection of Township Road 137 and State Route 274, and 200 feet north of Township Road 137:

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam; moderate fine granular structure; friable; many roots; slightly acid; abrupt smooth boundary.

B1—7 to 9 inches; yellowish brown (10YR 5/4) silty clay loam; moderate fine subangular blocky structure; firm; common roots; thin very patchy brown (10YR 5/3) coatings on faces of peds; medium acid; clear wavy boundary.

B21t—9 to 16 inches; dark yellowish brown (10YR 4/4) clay; moderate medium subangular blocky structure; firm; common roots; thin patchy brown (10YR 5/3) clay films on faces of peds; 10 percent gravel; common distinct black (10YR 2/1) stains; medium acid; clear wavy boundary.

B22t—16 to 24 inches; yellowish brown (10YR 5/4) clay; common fine distinct gray (10YR 5/1) and grayish brown (10YR 5/2) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; common roots; thin patchy brown (10YR 5/3) and dark brown (10YR 4/3) clay films on faces of peds; 10 percent gravel; neutral; clear wavy boundary.

B31t—24 to 31 inches; yellowish brown (10YR 5/4) heavy clay loam; many fine distinct grayish brown (10YR 5/2) mottles; weak coarse angular blocky structure; firm; thin very patchy dark grayish brown (10YR 4/2) clay films on faces of peds; patchy light gray (10YR 6/1) calcium carbonate accumulations on faces of peds; 10 percent gravel; slight effervescence; moderately alkaline; clear wavy boundary.

B32—31 to 38 inches; yellowish brown (10YR 5/4) clay loam; common fine distinct grayish brown (10YR 5/2) mottles; weak coarse angular blocky structure; firm; patchy light brownish gray (2.5Y 6/2) calcium carbonate accumulations on faces of peds; 13 percent gravel; strong effervescence; moderately alkaline; clear wavy boundary.

C—38 to 60 inches; yellowish brown (10YR 5/4) clay loam; massive; firm; common light brownish gray (2.5Y 6/2) calcium carbonate accumulations in partings; 13 percent gravel; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 22 to 40 inches and the depth to carbonates from 16 to 36 inches. The content of coarse fragments ranges from 0 to 15 percent in the upper part of the solum and from 1 to 15 percent in the lower part and in the C horizon.

The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. It is medium acid to neutral. The B2t horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is heavy silty clay loam, silty clay, or clay. The upper part of the B horizon is strongly acid to neutral, and the lower part is slightly acid to moderately alkaline.

## Haskins series

The Haskins series consists of deep, somewhat poorly drained soils formed in moderately permeable outwash over slowly or very slowly permeable glacial till or lacustrine material. These soils are on terraces and outwash plains. Slope ranges from 0 to 6 percent.

Haskins soils are commonly adjacent to Fulton and Homer soils. Fulton soils formed in lake-laid sediments on lake plains. Homer soils formed in glacial outwash on outwash plains and in melt water channels.

Typical pedon of Haskins loam, 0 to 2 percent slopes, in Bloomfield Township, 4 miles southwest of Russells Point, NE1/4NW1/4 sec. 15, T. 7 S., R. 8 E., 660 feet east of the intersection of Township Road 80 and County Road 54, and 2,475 feet southwest of the intersection of State Route 274 and County Road 54:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam; moderate fine granular structure; friable; many roots; 5 percent gravel; neutral; abrupt smooth boundary.

B21t—8 to 13 inches; yellowish brown (10YR 5/4) clay loam; few fine faint yellowish brown (10YR 5/6) and few fine distinct dark grayish brown (10YR 4/2) mottles; moderate fine subangular blocky structure; firm; common roots; thin patchy grayish brown (10YR 5/2) clay films on faces of peds; 10 percent gravel; slightly acid; clear wavy boundary.

B22t—13 to 22 inches; yellowish brown (10YR 5/4) sandy clay loam; common medium distinct dark gray (10YR 4/1) and grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; common roots; faces of peds coated grayish brown

(10YR 5/2); thin patchy clay films on faces of peds; 10 percent gravel; mildly alkaline; clear wavy boundary.

B23t—22 to 32 inches; yellowish brown (10YR 5/4) clay loam; common medium distinct dark gray (10YR 4/1) mottles; moderate medium subangular blocky structure; firm; common roots; faces of peds coated dark gray (10YR 4/1); thin patchy clay films on faces of peds; 10 percent gravel; mildly alkaline; clear wavy boundary.

B31—32 to 36 inches; yellowish brown (10YR 5/4) sandy loam; weak medium subangular blocky structure; firm; slight effervescence; mildly alkaline; abrupt smooth boundary.

IIB32—36 to 40 inches; brown (10YR 5/3) silty clay; weak medium subangular blocky structure; firm; patchy light gray (10YR 7/1) calcium carbonate accumulations on faces of peds; slight effervescence; moderately alkaline; clear wavy boundary.

IIC1—40 to 48 inches; yellowish brown (10YR 5/4) silty clay; massive; firm; patchy light gray (10YR 7/1) calcium carbonate accumulations in partings; slight effervescence; moderately alkaline; clear wavy boundary.

IIC2—48 to 54 inches; brown (10YR 5/3) clay; massive; firm; patchy gray (10YR 5/1) calcium carbonate accumulations in partings; strong effervescence; moderately alkaline; clear wavy boundary.

IIC3—54 to 64 inches; dark grayish brown (2.5Y 4/2) clay; massive; firm; patchy light gray (10YR 6/1) calcium carbonate accumulations in partings; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 26 to 42 inches and the depth to carbonates from 20 to 39 inches. The content of gravel ranges from 2 to 20 percent in the upper part of the solum and from 0 to 10 percent in the lower part.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2. It is neutral or slightly acid. The B horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is dominantly clay loam or sandy clay loam, but in some pedons it has layers of heavy loam or thin strata of sandy loam or is gravelly. It is slightly acid or medium acid in the upper part and slightly acid to mildly alkaline in the lower part. The IIB horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 3. It is clay or silty clay. The IIC horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It is heavy clay loam, clay, or silty clay.

## Henshaw series

The Henshaw series consists of deep, somewhat poorly drained, moderately slowly permeable soils formed in lake-laid sediments on lake plains and terraces. Slope ranges from 0 to 6 percent.

The Henshaw soils in Logan County have a grayer solum than is defined as the range for the Henshaw series. This difference, however, does not alter the use or behavior of the soils.

Henshaw soils are similar to Del Rey and Fulton soils, but they contain less clay in the subsoil.

Typical pedon of Henshaw silt loam, 0 to 2 percent slopes, in Union Township, about 4 miles southwest of Bellefontaine, NE1/4NW1/4 sec. 7, 135 feet south of County Road 43, and 925 feet west of the intersection of County Road 43 and Township Road 198:

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam; moderate medium granular structure; friable; common roots; slightly acid; abrupt smooth boundary.

B1—7 to 12 inches; light yellowish brown (2.5Y 6/4) silt loam; common medium distinct grayish brown (2.5Y 5/2) mottles; moderate medium angular blocky structure; friable; common roots; patchy grayish brown (2.5Y 5/2) coatings on faces of peds; about 2 percent gravel; medium acid; clear wavy boundary.

B21tg—12 to 18 inches; grayish brown (2.5Y 5/2) light silty clay loam; many medium distinct light brownish gray (2.5Y 6/2) and light olive brown (2.5Y 5/3) mottles; moderate medium angular blocky structure; firm; common roots; thin patchy light brownish gray (2.5Y 6/2) clay films on faces of peds; about 2 percent gravel; slightly acid; clear wavy boundary.

B22tg—18 to 23 inches; grayish brown (2.5Y 5/2) light silty clay loam; many medium distinct gray (10YR 6/1) mottles; moderate medium subangular blocky structure; firm; common roots; thin patchy gray (10YR 6/1) clay films on faces of peds; about 2 percent gravel; slightly acid; clear wavy boundary.

B23tg—23 to 28 inches; gray (10YR 6/1) silty clay loam; many medium distinct brown (10YR 4/3) mottles; moderate medium and coarse angular blocky structure; firm; common roots; thin patchy gray (10YR 6/1) clay films on faces of peds; about 2 percent gravel; slightly acid; clear wavy boundary.

B31—28 to 34 inches; brown (10YR 4/3) silty clay loam; many medium distinct gray (10YR 6/1) and common medium faint yellowish brown (10YR 5/6) mottles; firm; common gray (10YR 6/1) coatings on faces of peds; slightly acid; clear wavy boundary.

B32g—34 to 41 inches; light brownish gray (10YR 6/2) silt loam; many medium distinct yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; firm; common gray (10YR 6/1) coatings on faces of peds; common black (10YR 2/1) stains; slight effervescence; mildly alkaline; clear wavy boundary.

B33—41 to 48 inches; yellowish brown (10YR 5/4) silt loam; many medium distinct gray (10YR 6/1) mottles; weak medium subangular blocky structure; firm; common gray (10YR 6/1) coatings on faces of

peds; common black (10YR 2/1) stains; slight effervescence; mildly alkaline; clear wavy boundary.

C1—48 to 55 inches; yellowish brown (10YR 5/4) silt loam; common medium faint yellowish brown (10YR 5/6) mottles; massive; firm; common gray (10YR 6/1) and black (10YR 2/1) coatings in partings; slight effervescence; moderately alkaline; clear wavy boundary.

C2—55 to 63 inches; yellowish brown (10YR 5/4) silt loam; common medium faint yellowish brown (10YR 5/6) and common medium distinct gray (10YR 6/1) mottles; massive; firm; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 35 to 50 inches. The upper part of the B horizon is strongly acid to neutral, and the lower part is slightly acid to mildly alkaline.

The Ap horizon has hue of 10YR or 2.5Y, value of 4, and chroma of 2. The B horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4. The B2 horizon is mainly silty clay loam and ranges, by weighted average, from 30 to 35 percent clay. The C horizon is dominantly silt loam or silty clay loam, but it has strata of silty clay or loam in many pedons.

## Homer series

The Homer series consists of deep, somewhat poorly drained soils formed in loamy outwash over sand and gravel on glacial outwash plains and terraces. Permeability is moderate in the subsoil and very rapid in the substratum. Slope ranges from 0 to 6 percent.

In most areas the Homer soils in Logan County have a neutral or mildly alkaline subsoil, which is outside the limits defined as the range for the Homer series. This difference, however, does not alter the use or behavior of the soils.

Homer soils are commonly adjacent to Eldean and Lippincott soils and are similar to Haskins and Sleeth soils. Eldean soils are slightly higher on the landscape than Homer soils and have a less gray subsoil. Haskins soils formed in outwash over glacial till or lacustrine material. Lippincott soils are wetter than Homer soils, contain more clay in the subsoil, and have a mollic epipedon. Sleeth soils have a thicker solum than Homer soils. Also, the texture of the subsoil of Sleeth soils does not contrast so strongly with the texture of the substratum.

Typical pedon of Homer silt loam, 0 to 2 percent slopes, in Monroe Township, about 2 miles northeast of West Liberty, SE1/4SE1/4 sec. 23, R. 13, T. 5, about 560 feet west of County Road 1, and 3,730 feet south of the intersection of County Roads 1 and 5:

Ap1—0 to 9 inches; dark brown (10YR 4/3) silt loam; moderate fine granular structure; friable; common roots; about 2 percent gravel; neutral; abrupt smooth boundary.

Ap2—9 to 11 inches; dark brown (10YR 4/3) silt loam; many brown (10YR 5/3) and pale brown (10YR 6/3) specks; moderate fine subangular blocky structure; friable; common roots; about 2 percent gravel; neutral; abrupt smooth boundary.

B1—11 to 14 inches; brown (10YR 4/3) silt loam; common medium faint yellowish brown (10YR 5/4) and dark grayish brown (10YR 4/2) mottles; moderate fine subangular blocky structure; friable; common roots; about 2 percent gravel; neutral; clear wavy boundary.

B21t—14 to 18 inches; yellowish brown (10YR 5/4) light silty clay loam; common medium distinct dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; common roots; about 60 percent of the faces of peds coated dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2); thin patchy clay films on faces of peds; few very dark grayish brown (10YR 3/2) concretions; about 2 percent gravel; neutral; clear wavy boundary.

B22t—18 to 23 inches; yellowish brown (10YR 5/4) clay loam; common medium distinct dark gray (10YR 4/1) and gray (10YR 5/1) mottles; moderate medium subangular blocky structure; firm; about 75 percent of the faces of peds coated dark gray (10YR 4/1) and very dark grayish brown (10YR 3/2); thin patchy very dark grayish brown (10YR 3/2) clay films on faces of peds; mildly alkaline; clear wavy boundary.

B23tg—23 to 29 inches; gray (10YR 5/1) light clay; common medium distinct yellowish brown (10YR 5/4, 5/6) mottles; moderate coarse subangular blocky structure; firm; common roots; about 50 percent of the faces of peds coated gray (10YR 5/1); thin patchy very dark grayish brown (10YR 3/2) clay films on faces of peds; few 2-inch black (10YR 2/1) krotovinas; 5 percent gravel; mildly alkaline; clear wavy boundary.

IIB24tg—29 to 33 inches; dark gray (10YR 4/1) gravelly clay loam; common medium distinct yellowish brown (10YR 5/4) and common medium faint gray (10YR 5/1) mottles; moderate coarse subangular blocky structure; firm; common roots; thin patchy clay films on faces of peds and coating pebbles; 30 percent gravel; common light yellowish brown (10YR 6/4) weathered limestone fragments; slight effervescence; mildly alkaline; clear wavy boundary.

IIB3—33 to 39 inches; pale brown (10YR 6/3) gravelly loam; weak medium subangular blocky structure; firm; common roots; many light yellowish brown (10YR 6/4) weathered limestone fragments; 30 percent gravel; slight effervescence; mildly alkaline; clear wavy boundary.

IIC1—39 to 50 inches; brown (10YR 5/3) gravelly sand; single grained; loose; 30 percent gravel; strong ef-

fervescence; moderately alkaline; clear wavy boundary.

IIC2—50 to 60 inches; light brownish gray (10YR 6/2) gravelly sand; single grained; loose; 30 percent gravel; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 40 inches and the depth to free carbonates from 26 to 40 inches. The upper part of the solum is slightly acid or neutral, and the lower part is mildly alkaline. The content of gravel ranges, by volume, from 0 to 5 percent in the A horizon and in the upper part of the B horizon and from 10 to 60 percent in the lower part of the B horizon.

The Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 2 or 3. The B1 and B2 horizons have hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4. The upper part of the B2t horizon is silty clay loam or clay loam. The lower part is dominantly clay loam and gravelly clay loam but has subhorizons of clay or gravelly clay in some pedons. The B3 horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. It is sandy loam, loam, or clay loam or the gravelly analogs of these textures. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4.

## Latty series

The Latty series consists of deep, very poorly drained, very slowly permeable soils formed in lake-laid sediments on lake plains and flood plains. Slope is 0 to 2 percent.

Latty soils are commonly adjacent to Fulton soils and are similar to Paulding and Wetzel soils. Fulton soils, which are on very slight rises, are better drained than Latty soils. The B and C horizons of Paulding soils contain more clay than those of Latty soils. Wetzel soils formed in glacial till and have an argillic horizon.

Typical pedon of Latty silty clay, in Stokes Township, SE1/4SW1/4 sec. 34, T. 6 S., R. 8 E., about 2 miles west of Russells Point, 2,770 feet west of the intersection of Township Road 52 and State Route 235, and 130 feet north of Township Road 52:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silty clay; weak coarse angular blocky structure parting to weak fine angular blocky; firm; many roots; slightly acid; abrupt smooth boundary.

B21g—8 to 15 inches; dark gray (10YR 4/1) silty clay; common medium distinct yellowish brown (10YR 5/4) mottles; weak medium prismatic structure parting to weak medium angular blocky; firm; common roots; continuous thin very dark gray (10YR 3/1) coatings on faces of peds; neutral; clear wavy boundary.

B22g—15 to 19 inches; dark gray (5Y 4/1) silty clay; common medium distinct yellowish brown (10YR 5/4) mottles; moderate medium prismatic structure parting to moderate medium angular blocky; firm; common roots; continuous dark gray (5Y 4/1) coatings on faces of peds; neutral; clear wavy boundary.

B23g—19 to 28 inches; olive gray (5Y 5/2) silty clay; many medium distinct dark yellowish brown (10YR 4/4) mottles; moderate medium prismatic structure parting to moderate medium angular blocky; firm; continuous olive gray (5Y 5/2) coatings on faces of peds; mildly alkaline; clear wavy boundary.

B24g—28 to 38 inches; gray (10YR 5/1) silty clay; common medium distinct yellowish brown (10YR 5/4, 5/6) mottles; moderate coarse prismatic structure parting to moderate medium angular blocky; firm; continuous gray (10YR and 5Y 5/1) coatings on faces of peds; mildly alkaline; clear wavy boundary.

B3—38 to 44 inches; dark yellowish brown (10YR 4/4) silty clay; common medium distinct gray (10YR 5/1) mottles; weak coarse prismatic structure parting to weak coarse angular blocky; firm; continuous gray (10YR 5/1) coatings on faces of peds; slight effervescence; mildly alkaline; clear wavy boundary.

C1—44 to 58 inches; yellowish brown (10YR 5/4) silty clay; massive; firm; continuous gray (10YR 5/1) coatings in partings; strong effervescence; moderately alkaline; clear wavy boundary.

C2—58 to 70 inches; dark yellowish brown (10YR 4/4) clay; massive; firm; continuous gray (10YR 5/1) coatings in partings; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 40 to 60 inches. Reaction is neutral or slightly acid in the A horizon and the upper part of the B horizon and neutral or mildly alkaline in the lower part.

The Ap horizon has hue of 10YR or 2.5Y, value of 4, and chroma of 1 or 2. The Bg horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 or 2. It is silty clay or clay. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 4. It ranges from 35 to 60 percent clay. It is dominantly clay or silty clay in areas on lake plains and heavy silty clay loam and heavy clay loam in areas on flood plains.

## Linwood series

The Linwood series consists of deep, very poorly drained, moderately permeable soils formed in organic material that is 16 to 51 inches deep over loamy mineral material. These soils are in depressions in outwash plains, lake plains, and till plains. Slope is 0 to 2 percent.

Linwood soils are commonly adjacent to the Carlisle, Edwards, Martisco, Muskego, and Willette soils. Carlisle soils formed in a thicker organic deposit. Edwards and Martisco soils formed in organic material over marl and Muskego soils in organic material over sedimentary peat. Willette soils have a substratum of clayey or silty deposits below a depth of 16 to 50 inches.

Typical pedon of Linwood muck, in Jefferson Township, about 4 miles east of Bellefontaine, 5,120 feet

east-southeast of the intersection of State Route 47 and County Road 25, and 2,700 feet south of State Route 47:

Oa1—0 to 5 inches; very dark brown (10YR 2/2) broken face, black (10YR 2/1) rubbed sapric material; about 5 percent fiber, less than 5 percent rubbed; moderate medium granular structure; friable; many roots; mildly alkaline; clear wavy boundary.

Oa2—5 to 10 inches; very dark brown (10YR 2/2) broken face, black (10YR 2/1) rubbed sapric material; about 5 percent fiber, less than 5 percent rubbed; moderate medium and coarse subangular blocky structure; friable; many roots; mildly alkaline; clear wavy boundary.

Oa3—10 to 17 inches; very dark brown (10YR 2/2) broken face, black (10YR 2/1) rubbed sapric material; about 25 percent fiber, less than 5 percent rubbed; moderate coarse subangular blocky structure; friable; common roots; mildly alkaline; clear wavy boundary.

Oa4—17 to 27 inches; very dark brown (10YR 2/2) broken face and rubbed sapric material; about 40 percent fiber, less than 4 percent rubbed; massive; firm; common roots; about 10 percent woody fragments; mildly alkaline; clear wavy boundary.

Oa5—27 to 39 inches; black (10YR 2/1) broken face, very dark brown (10YR 2/2) rubbed sapric material; about 30 percent fiber, less than 5 percent rubbed; massive; firm; about 10 percent mineral material; mildly alkaline; clear wavy boundary.

Oa6—39 to 43 inches; black (10YR 2/1) broken face, very dark brown (10YR 2/2) rubbed sapric material; about 20 percent fiber, 8 percent rubbed; massive; firm; mildly alkaline; clear wavy boundary.

IIC1g—43 to 50 inches; gray (5Y 5/1) silt loam; massive; firm; about 5 percent shells; strong effervescence; moderately alkaline; clear wavy boundary.

IIC2g—50 to 60 inches; gray (10YR 6/1) silt loam; massive; firm; about 5 percent shells; strong effervescence; moderately alkaline.

Depth to the IIC horizon ranges from 16 to 51 inches. The solum ranges from strongly acid to mildly alkaline.

The surface tier has hue of 10YR to 2.5Y, value of 2, and chroma of 0 to 2. The subsurface and bottom tiers have hue of 10YR to 5YR, or are neutral in hue, and have value of 2 or 3, and chroma of 1 to 3, broken face and rubbed. Some pedons have horizons of hemic material, less than 10 inches thick, in the lower part of the organic material. The C horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2.

## Lippincott series

The Lippincott series consists of deep, very poorly drained soils formed in loamy and clayey outwash over stratified sand and gravel on outwash plains, terraces, and valley trains. Permeability is moderate in the solum and rapid in the substratum. Slope is 0 to 2 percent.

Lippincott soils are commonly adjacent to Montgomery and Westland soils and are similar to Westland soils. Montgomery soils formed in lacustrine sediments on slack water terraces. Westland soils have a thicker solum than Lippincott soils.

Typical pedon of Lippincott silty clay loam, in Liberty Township, NE1/4NE1/4 sec. 33, R. 13, T. 5, about 2,904 feet west of U.S. Route 68 and 2,180 feet north of State Route 245:

Ap—0 to 12 inches; very dark gray (10YR 3/1) silty clay loam; moderate fine granular structure; friable; many roots; neutral; abrupt smooth boundary.

B21gt—12 to 15 inches; dark gray (10YR 4/1) clay; common fine distinct yellowish brown (10YR 5/4) mottles; moderate medium angular blocky structure; firm; many roots; thin patchy dark gray (10YR 4/1) clay films on faces of peds; neutral; clear wavy boundary.

B22gt—15 to 22 inches; gray (10YR 5/1) clay; many medium prominent brownish yellow (10YR 6/6) mottles; moderate medium angular blocky structure; firm; common roots; thin patchy gray (10YR 5/1) clay films on faces of peds; mildly alkaline; clear wavy boundary.

IIB3g—22 to 27 inches; gray (10YR 6/1) very gravelly loam; massive; very friable; many light gray (10YR 7/1) partially weathered dolomitic pebbles; 60 percent gravel; slight effervescence; mildly alkaline; clear wavy boundary.

IICg—27 to 60 inches; light brownish gray (10YR 6/2) very gravelly sand; single grained; loose; 70 percent gravel; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 22 to 33 inches and the depth to free carbonates from 17 to 33 inches. Reaction ranges from neutral or slightly acid in the A horizon to mildly alkaline in the lower part of the B horizon; the alkalinity generally increases with increasing depth. The content of gravel ranges, by volume, from 0 to 15 percent in the A and B2 horizons, from 15 to 60 percent in the B3 horizon, and from 35 to 70 percent in the C horizon.

The Ap horizon has hue of 10YR or N, value of 2 or 3, and chroma of 0 or 1. The B2 horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is clay or silty clay. The B3 horizon has hue of 10YR, value of 4 to 6, and chroma of 1 or 2. It is gravelly loam or very gravelly loam.

## Martisco series

The Martisco series consists of deep, very poorly drained soils formed in a mantle of silty material over marl. These soils are in depressions in lake plains. Per-

meability is moderate or moderately rapid in the silty material and slow in the marl. Slope is 0 to 2 percent.

Martisco soils are commonly adjacent to the Martisco Variant and the Patton Variant and are similar to Edwards soils. Edwards soils formed in organic deposits over marl. The Martisco Variant does not have a histic epipedon. Patton soils formed in silty lacustrine sediments.

Typical pedon of Martisco mucky silt loam, in Rush Creek Township, about 6 miles northeast of Bellefontaine, 5,150 feet east of the intersection of County Roads 9 and 25, west of Rush Creek:

A11—0 to 10 inches; very dark brown (10YR 2/2) mucky silt loam; weak medium granular structure; friable; many roots; about 20 percent organic matter; strong effervescence; moderately alkaline; abrupt smooth boundary.

A12—10 to 16 inches; very dark gray (10YR 3/1) silt loam; weak medium subangular blocky structure; friable; common roots; many light gray (10YR 6/1) shells and shell fragments; strong effervescence; moderately alkaline; abrupt irregular boundary.

C—16 to 25 inches; gray (5Y 5/1) silt loam; common coarse distinct dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) mottles; moderate coarse prismatic structure; firm; common roots; 20 percent shells; strong effervescence; moderately alkaline; clear wavy boundary.

Lca1—25 to 32 inches; light gray (2.5Y 7/2) marl; common medium distinct yellowish brown (10YR 5/6) mottles; massive; firm; common roots; common dark yellowish brown (10YR 4/4) root channels; common white (10YR 8/2) shell fragments; strong effervescence; moderately alkaline; clear wavy boundary.

Lca2—32 to 40 inches; light gray (2.5Y 7/2) marl; few fine distinct yellowish brown (10YR 5/4) mottles; massive; friable; common white (10YR 8/2) shell fragments; several black (10YR 2/1) lenses; strong effervescence; moderately alkaline; gradual smooth boundary.

Lca3—40 to 60 inches; light gray (2.5Y 7/2) marl; few fine distinct yellowish brown (10YR 5/4) mottles; massive; friable; common white (10YR 8/2) shell fragments; strong effervescence; moderately alkaline.

The A11 horizon is 8 to 16 inches thick. It has hue of 10YR, value of 2, and chroma of 1 or 2. It is mildly alkaline or moderately alkaline. The C horizon has hue of 5Y to 10YR, value of 5, and chroma of 1. It is silt loam or silty clay loam. The Lca horizon has hue of 2.5Y or 10YR, value of 5 to 8, and chroma of 1 or 2.

## Martisco Variant

The Martisco Variant consists of deep, very poorly drained soils formed in a thin silty mantle over marl. These soils are in depressions in lake plains. Permeability is moderate in the silty mantle. Slope is 0 to 2 percent.

The Martisco Variant is commonly adjacent to other Martisco soils and to the Patton Variant. The other Martisco soils have a histic epipedon. The Patton Variant formed in silty lacustrine sediments.

Typical pedon of Martisco Variant silt loam, in Rush Creek Township, about 3 1/2 miles northeast of Bellefontaine, 8,150 feet northeast of the intersection of State Route 47 and County Road 25, and 300 feet east of Township Road 136, where the road crosses Rush Creek:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, grayish brown (10YR 5/2) dry; weak very fine granular structure; friable; common roots; about 5 percent shell fragments; strong effervescence; moderately alkaline; abrupt smooth boundary.

Lca1—8 to 17 inches; gray (10YR 5/1) silty marl; weak fine subangular blocky structure; friable; common roots; common fine distinct light olive brown (2.5Y 5/4) and very pale brown (10YR 7/4) vertical root channels; strong effervescence; moderately alkaline; clear wavy boundary.

Lca2—17 to 21 inches; light gray (10YR 6/1) silty marl; massive; friable; few roots; about 50 percent shell fragments; strong effervescence; moderately alkaline; clear wavy boundary.

Lca3—21 to 30 inches; light gray (10YR 7/1) silty marl; massive; friable; few roots; many medium distinct yellow (10YR 7/6) and brownish yellow (10YR 6/6) root channels with yellowish red (5YR 4/6) edges; about 10 percent shell fragments; strong effervescence; moderately alkaline; clear wavy boundary.

Lca4—30 to 34 inches; light gray (10YR 6/1) silty marl; massive; friable; few roots; many medium distinct yellow (10YR 7/6) and brownish yellow (10YR 6/6) root channels; about 70 percent shell fragments; strong effervescence; moderately alkaline; clear wavy boundary.

Lca5—34 to 45 inches; light gray (10YR 7/2) silty marl; massive; friable; common medium distinct yellow (10YR 7/6) and brownish yellow (10YR 6/6) root channels; about 10 percent shell fragments; strong effervescence; moderately alkaline; clear wavy boundary.

Lca6—45 to 60 inches; light gray (10YR 6/1) and white (10YR 8/1) silty marl; massive; friable; common medium distinct yellow (10YR 7/6) and brownish yellow (10YR 6/6) root channels; about 10 percent shell fragments; strong effervescence; moderately alkaline.

The Ap horizon has hue of 10YR or 2.5Y, value of 4, and chroma of 2. The Lca horizon has hue of 2.5Y or 10YR, value of 5 to 8, and chroma of 1 or 2.

## Miamian series

The Miamian series consists of deep, well drained, moderately slowly permeable soils on ground moraines and end moraines. These soils formed in calcareous glacial till capped by a thin layer of loess. Slope ranges from 2 to 50 percent.

Miamian soils are commonly adjacent to Celina and Crosby soils and are similar to the Miamian Variant and to Milton and Morley soils. Celina and Crosby soils are on low knolls and flats. They are gray in the upper part of the argillic horizon. The Miamian Variant and Milton soils, which are on bedrock-controlled landforms, are moderately deep to bedrock. Miamian and Morley soils are in similar positions on the landscape, but Morley soils contain more clay in the subsoil and substratum. Also, they are of illitic mineralogy.

Typical pedon of Miamian silt loam, 2 to 6 percent slopes, in Monroe Township, about 6 miles east of West Liberty, 4,158 feet west of the intersection of State Route 287 and Township Road 150, and 100 feet south of State Route 287:

Ap—0 to 6 inches; dark brown (10YR 5/3) silt loam; moderate fine granular structure; friable; many roots; 2 percent gravel; slightly acid; abrupt smooth boundary.

B21t—6 to 10 inches; dark yellowish brown (10YR 4/4) clay loam; moderate fine subangular blocky structure; firm; many roots; thin patchy clay films on faces of peds; 5 percent gravel; medium acid; clear wavy boundary.

B22t—10 to 21 inches; dark yellowish brown (10YR 4/4) clay; strong medium subangular blocky structure; firm; thin patchy dark yellowish brown (10YR 3/4) clay films on faces of peds; few fine distinct black (10YR 2/1) stains; 10 percent gravel; strongly acid; clear wavy boundary.

B3—21 to 27 inches; yellowish brown (10YR 5/4) loam; weak medium subangular blocky structure; firm; common white (10YR 8/1) coatings on faces of peds; 10 percent gravel; slight effervescence; mildly alkaline; clear wavy boundary.

C1—27 to 34 inches; yellowish brown (10YR 5/4) loam; massive; firm; few white (10YR 8/1) coatings in very weak structural breaks; 10 percent gravel; strong effervescence; moderately alkaline; clear wavy boundary.

C2—34 to 60 inches; yellowish brown (10YR 5/4) loam; massive; firm; 10 percent gravel; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 40 inches and the depth to free carbonates from 20 to 36 inches. Reaction ranges from medium acid to neutral in the A horizon, from strongly acid to neutral in the upper part of the B horizon, and from slightly acid to mildly alkaline in the lower part. The content of coarse fragments in the solum ranges, by volume, from 2 to 15 percent.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The B2 horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4. It is clay, silty clay loam, or clay loam. The B3 horizon has hue of 10YR, value of 4 or 5, and chroma of 4. It is loam, clay loam, or silty clay loam. The C horizon has hue of 10YR, value of 5, and chroam of 3 or 4. It is loam or silt loam and is mildly alkaline or moderately alkaline.

## Miamian Variant

The Miamian Variant consists of moderately deep, well drained, moderately slowly permeable soils on glaciated uplands. These soils formed in glacial till overlying acid shale bedrock at a depth of 24 to 40 inches. Slope ranges from 6 to 15 percent.

The Miamian Variant is commonly adjacent to Berks and Weikert soils and is similar to other Miamian soils and to Milton soils. Berks and Weikert soils have a lower base status than the Miamian Variant and contain more shale fragments and less clay in the solum. Also, Weikert soils are shallow to bedrock. The other Miamian soils are deep to bedrock, and Milton soils are underlain by limestone bedrock.

Typical pedon of Miamian Variant silt loam, 6 to 15 percent slopes, moderately eroded, in Jefferson Township, about 1 1/2 miles north of Zanesfield, 1,980 feet northeast of the intersection of County Roads 5 and 25, and 90 feet east of County Road 5:

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam; common specks of dark yellowish brown (10YR 3/4) clay; moderate fine granular structure; friable; many roots; neutral; clear wavy boundary.

B21t—7 to 13 inches; dark brown (10YR 4/3) clay; moderate medium subangular blocky structure; firm; thin patchy dark yellowish brown (10YR 3/4) clay films on faces of peds; 5 percent gravel; slightly acid; clear wavy boundary.

B22t—13 to 22 inches; dark yellowish brown (10YR 3/4) clay; moderate medium subangular blocky structure; firm; thin patchy clay films on faces of peds; 15 percent gravel; slightly acid; clear wavy boundary.

C—22 to 35 inches; yellowish brown (10YR 5/4) gravelly loam; massive; firm; 30 percent gravel; slight effervescence; mildly alkaline; clear wavy boundary.

IICr—35 inches; shale bedrock.

The thickness of the solum ranges from 20 to 40 inches and the depth to bedrock from 24 to 40 inches. Reaction is slightly acid or neutral in the A horizon and the upper part of the B horizon and slightly acid to mildly

alkaline in the lower part. The content of coarse fragments ranges, by volume, from 0 to 15 percent in the solum and from 10 to 35 percent in the C horizon.

The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. The B horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 3 or 4. It is clay or clay loam. The C horizon has hue of 10YR, value of 5, and chroma of 3 or 4. It is loam or silt loam or the gravelly analogs of these textures. It is mildly alkaline or moderately alkaline.

## Milton series

The Milton series consists of moderately deep, well drained soils formed in glacial till and the underlying residuum of limestone. These soils are on glaciated uplands. Permeability is moderate or moderately slow. Slope ranges from 2 to 18 percent.

Milton soils are commonly adjacent to Miamian soils and are similar to the Miamian Variant and Morley soils. Miamian and Morley soils are deep to bedrock. The Miamian Variant is moderately deep to acid shale bedrock.

Typical pedon of Milton silt loam, 12 to 18 percent slopes, moderately eroded, in McArthur Township, about 3 miles east of Huntsville, 360 feet east of County Road 49, and 3,870 feet south of the intersection of State Route 274 and County Road 49:

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam; common specks of dark yellowish brown (10YR 4/4) clay; moderate fine granular structure; friable; common roots; 10 percent gravel; neutral; abrupt smooth boundary.

B21t—6 to 15 inches; brown (7.5YR 4/4) light clay; moderate medium subangular blocky structure; firm; common roots; thin patchy dark yellowish brown (10YR 4/4) clay films on faces of peds; 10 percent gravel; slightly acid; clear wavy boundary.

B22t—15 to 25 inches; brown (7.5YR 4/4) clay; moderate medium subangular blocky structure; firm; common roots; thin patchy dark yellowish brown (10YR 3/4) clay films on faces of peds; common black (10YR 2/1) stains; 10 percent gravel; neutral; clear wavy boundary.

B23t—25 to 28 inches; dark brown (10YR 4/3) clay; moderate medium subangular blocky structure; firm; common roots; thin patchy dark yellowish brown (10YR 3/4) clay films on faces of peds; about 12 percent gravel; mildly alkaline; clear wavy boundary.

IIB3—28 to 34 inches; dark yellowish brown (10YR 4/4) clay loam; weak medium subangular blocky structure; firm; 12 percent fragments of partially weathered limestone; slight effervescence; mildly alkaline; clear irregular boundary.

IIR—34 inches; limestone bedrock.

The thickness of the solum, or the depth to bedrock, ranges from 20 to 40 inches. Reaction is slightly acid or neutral in the A horizon and the upper part of the B horizon and neutral or mildly alkaline in the lower part of the B horizon. The content of coarse fragments ranges, by volume, from 1 to 12 percent in the solum.

The Ap horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. The specks in this horizon are dark yellowish brown (10YR 4/4) or dark brown (10YR 4/3) silty clay or clay. They are not evident in some pedons. The B horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is clay, silty clay loam, or heavy clay loam. Some pedons have a IIB3 horizon. This horizon is less than 15 inches thick. In some pedons the lower part of the B horizon contains limestone fragments.

## Montgomery series

The Montgomery series consists of deep, very poorly drained soils formed in fine textured and moderately fine textured sediments in flat or depressional areas on slack water terraces and till plains. Permeability is slow or very slow. Slope is 0 to 2 percent.

The Montgomery soils in Logan county have higher chroma colors in the B3 and C horizons than is defined as the range for the Montgomery series. This difference, however, does not alter the use or behavior of the soils.

Montgomery soils are commonly adjacent to Del Rey and Shinrock soils and are similar to Latty and Patton soils. Del Rey and Shinrock soils are better drained than Montgomery soils. Del Rey soils are on broad flats and convex knolls, and Shinrock soils are along drainageways and on convex knolls and ridgetops. Latty soils do not have a mollic epipedon. Patton soils contain less clay in the subsoil and substratum than Montgomery soils.

Typical pedon of Montgomery silty clay loam, in Miami Township, NW1/4NE1/4 sec. 5, R. 13, T. 3, about 1 mile southeast of DeGraff, 2,080 feet southeast of the intersection of State Route 508 and Township Road 30, and 430 feet south of Township Road 30:

Ap—0 to 10 inches; very dark gray (10YR 3/1) silty clay loam; moderate medium and coarse granular structure; friable; many roots; neutral; abrupt smooth boundary.

A12—10 to 16 inches; very dark gray (10YR 3/1) silty clay; common medium distinct olive brown (2.5Y 4/4) mottles; moderate medium angular blocky structure; firm; many roots; thin patchy black (10YR 2/1) coatings on faces of peds; neutral; clear wavy boundary.

B21g—16 to 23 inches; dark gray (N 4/0) silty clay; common medium distinct olive brown (2.5Y 4/4) mottles; moderate medium prismatic structure parting to moderate medium angular blocky; firm;

common roots; thin patchy dark gray (N 4/0) coatings on faces of peds; neutral; clear wavy boundary.

B22g—23 to 34 inches; dark gray (N 4/0) silty clay; common medium distinct light olive brown (2.5Y 5/4) mottles; moderate coarse prismatic structure parting to moderate medium angular blocky; firm; common roots; thin patchy very dark gray (N 3/0) coatings on faces of peds; common black (10YR 2/1) krotovinas; neutral; clear wavy boundary.

B3—34 to 46 inches; light olive brown (2.5Y 5/4) silty clay; many medium faint yellowish brown (10YR 5/4) mottles; moderate coarse prismatic structure parting to weak coarse angular blocky; firm; thin patchy gray (N 5/0) coatings on faces of peds; common black (10YR 2/1) krotovinas; neutral; clear wavy boundary.

C1—46 to 56 inches; light olive brown (2.5Y 5/4) silty clay; common medium faint yellowish brown (10YR 5/4) mottles; massive; firm; thin patchy light gray (N 6/0) coatings in partings; common black (10YR 2/1) krotovinas; slight effervescence; mildly alkaline; clear wavy boundary.

C2—56 to 68 inches; light olive brown (2.5Y 5/4) silty clay; massive; firm; thin patchy light gray (N 6/0) coatings in partings; few black (10YR 2/1) krotovinas; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 36 to 48 inches and the depth to free carbonates from 30 to 50 inches.

The A horizon is 10 to 16 inches thick. The Ap and A1 horizons have hue of 10YR, value of 1 to 3, and chroma of 0 to 2. The B2 horizon has hue of 10YR to 5Y or of N, value of 4 to 6, and chroma of 0 to 2. It is slightly acid to mildly alkaline. The B3 and C horizons have hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 to 4.

## Morley series

The Morley series consists of deep, well drained, slowly permeable soils formed in glacial till. These soils are on dissected parts of ground moraines and end moraines. Slope ranges from 6 to 18 percent.

In the Morley soils in Logan County, the B2 horizon is less acid than is defined as the range for the Morley series. This difference, however, does not alter the use or behavior of the soils.

Morley soils are commonly adjacent to Blount and Glynwood soils and are similar to Miamian and Milton soils. Blount soils have a dominant chroma of 2 or less either in the matrix of one or more subhorizons of the B horizon or on faces of peds in the argillic horizon. Glynwood soils have mottles with chroma of 2 or less in the upper 10 inches of the argillic horizon. Miamian and Milton soils are of mixed mineralogy. Milton soils are underlain by limestone bedrock at a depth of 20 to 40 inches.

Typical pedon of Morley silt loam, 6 to 12 percent slopes, moderately eroded, in Rush Creek Township, about 2 miles northeast of Rushsylvania, 890 feet northeast of the intersection of State Route 274 and Township Road 110:

Ap—0 to 8 inches; brown (10YR 4/3) silt loam; many small chunks of dark yellowish brown (10YR 4/4) clay; moderate medium and coarse granular structure; firm; common roots; about 10 percent gravel; slightly acid; abrupt smooth boundary.

B21t—8 to 15 inches; yellowish brown (10YR 5/4) clay; moderate medium subangular blocky structure; firm; common roots; thin patchy brown (10YR 4/3) clay films on faces of peds; about 10 percent gravel; slightly acid; clear wavy boundary.

B22t—15 to 21 inches; yellowish brown (10YR 5/4) clay; moderate medium subangular blocky structure; firm; few roots; thin patchy brown (10YR 4/3) clay films on faces of peds; about 10 percent gravel; mildly alkaline; clear wavy boundary.

B3—21 to 27 inches; yellowish brown (10YR 5/4) clay loam; weak coarse subangular blocky structure; firm; about 10 percent gravel; mildly alkaline; clear wavy boundary.

C—27 to 60 inches; yellowish brown (10YR 5/4) clay loam; massive; firm; about 10 percent gravel; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 32 inches. Reaction is slightly acid or neutral in the A horizon and the upper part of the B horizon and neutral or mildly alkaline in the lower part.

The Ap horizon is 6 to 8 inches thick. It has hue of 10YR, value of 4, and chroma of 2 or 3. The B horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 5. It is clay loam or clay. The content of coarse fragments ranges, by volume, from 5 to 10 percent. The C horizon has hue of 10YR, value of 5, and chroma of 3 or 4. It is clay loam or silty clay loam.

## Muskego series

The Muskego series consists of deep, very poorly drained soils formed in organic deposits over sedimentary peat in depressions. Permeability is moderately slow to moderately rapid in the organic deposits and slow in the sedimentary peat. Slope is 0 to 2 percent.

Muskego soils are commonly near Carlisle, Edwards, Linwood, Martisco, and Willette soils. Carlisle soils formed in organic deposits that are thicker than those in which Muskego soils formed. Edwards and Martisco soils formed in organic deposits over marl. Linwood soils have a loamy substratum and Willette soils a silty or clayey substratum.

Typical pedon of Muskego muck, in Bokes Creek Township, about 2 1/2 miles west of West Mansfield, 1,450 feet west-southwest of the intersection of State Route 47 and Township Road 131, and 530 feet south of State Route 47:

Oa1—0 to 5 inches; very dark brown (10YR 2/2) broken face and rubbed sapric material; about 10 percent fiber, less than 5 percent rubbed; moderate fine granular structure; friable; many roots; about 20 percent mineral material; very strongly acid; clear wavy boundary.

Oa2—5 to 10 inches; dark brown (7.5YR 3/2) broken face, very dark brown (10YR 2/2) rubbed sapric material; about 30 percent fiber, less than 5 percent rubbed; moderate very thin platy structure; friable; many roots; very strongly acid; clear wavy boundary.

Oa3—10 to 19 inches; dark brown (7.5YR 3/2) broken face and rubbed sapric material; about 40 percent fiber, less than 10 percent rubbed; massive; firm; common roots; medium acid; clear smooth boundary.

Oa4—19 to 26 inches; very dark brown (10YR 2/2) broken face, black (10YR 2/1) rubbed sapric material; about 40 percent fiber, less than 5 percent rubbed; massive; firm; medium acid; clear smooth boundary.

Oa5—26 to 30 inches; black (10YR 2/1) broken face and rubbed sapric material; about 60 percent fiber, less than 10 percent rubbed; massive; firm; medium acid; clear smooth boundary.

Oe6—30 to 35 inches; very dark grayish brown (10YR 3/2) broken face and rubbed hemic material; about 80 percent fiber, 40 percent rubbed; mostly herbaceous fiber; massive; friable; medium acid; clear smooth boundary.

Oa7—35 to 41 inches; very dark gray (10YR 3/1) broken face, black (10YR 2/1) rubbed sapric material; about 50 percent fiber, less than 5 percent rubbed; massive; friable; medium acid; clear smooth boundary.

Lco1—41 to 47 inches; very dark grayish brown (2.5Y 3/2) coprogenous earth; massive; slightly plastic; slightly acid; clear smooth boundary.

Lco2—47 to 64 inches; very dark grayish brown (2.5Y 3/3) coprogenous earth; massive; slightly plastic; slightly acid; clear smooth boundary.

Lco3—64 to 75 inches; very dark grayish brown (2.5Y 3/2) coprogenous earth; massive; slightly plastic; slightly acid.

The depth to coprogenous earth ranges from 20 to 50 inches. The sapric material below the surface tier is medium acid to neutral.

The surface tier typically has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. The subsurface and bottom tiers have hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 0 to 3. These tiers are mainly sapric material, but thin layers of hemic material are in some pedons. The Lco horizon has hue of 2.5Y or 5Y, value of 3 or 4, and chroma of 2 or 3. It is slightly acid to mildly alkaline.

## Nappanee series

The Nappanee series consists of deep, somewhat poorly drained, very slowly permeable soils formed in calcareous glacial till on ground moraines and end moraines. Slope ranges from 0 to 6 percent.

Nappanee soils are commonly adjacent to Paulding and St. Clair soils and are similar to Blount and Crosby soils. St. Clair soils, which are on knolls, side slopes, and ridgetops, are better drained than Nappanee soils. Paulding soils are wetter than Nappanee soils, contain more clay in the subsoil, and have a grayer subsoil. Blount and Crosby soils contain less clay in the subsoil and the substratum.

Typical pedon of Nappanee silt loam, 2 to 6 percent slopes, in Richland Township, about 4 miles northeast of Huntsville, 2,180 feet northeast of the intersection of County Roads 108 and 49:

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam; moderate fine granular structure; friable; many roots; about 2 percent gravel; slightly acid; abrupt smooth boundary.

B21t—9 to 13 inches; brown (10YR 5/3) clay; many medium faint light brownish gray (10YR 6/2) and grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; common roots; thin patchy grayish brown (10YR 5/2) clay films on faces of peds; about 2 percent gravel; medium acid; clear wavy boundary.

B22t—13 to 17 inches; brown (10YR 4/3) clay; many medium faint grayish brown (10YR 5/2) and gray (10YR 5/1) mottles; moderate medium prismatic structure parting to weak medium blocky; firm; common roots; faces of peds coated dark grayish brown (10YR 4/2); thin patchy clay films on faces of peds; about 2 percent gravel; medium acid; clear wavy boundary.

B23t—17 to 26 inches; brown (10YR 4/3) clay; common medium distinct grayish brown (10YR 5/2) and many medium faint dark grayish brown (10YR 4/2) mottles; moderate medium prismatic structure parting to weak medium subangular blocky; firm; common roots; faces of peds coated dark grayish brown (10YR 4/2); thin patchy clay films on faces of peds; about 2 percent gravel; neutral; clear wavy boundary.

B3—26 to 33 inches; brown (10YR 5/3) clay; many medium distinct dark grayish brown (10YR 4/2) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; common roots; faces of peds coated dark grayish brown (10YR 4/2); about 2 percent gravel; slight effervescence; mildly alkaline; clear wavy boundary.

C1—33 to 50 inches; yellowish brown (10YR 5/4) silty clay; massive; firm; light gray (10YR 7/1) calcium carbonate accumulations in partings; about 2 per-

cent gravel; strong effervescence; moderately alkaline; clear wavy boundary.

C2—50 to 60 inches; yellowish brown (10YR 5/4) clay; massive; firm; light gray (10YR 7/1) calcium carbonate accumulations in partings; about 2 percent gravel; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 40 inches. Reaction ranges from medium acid to neutral in the upper part of the B horizon and is neutral or mildly alkaline in the lower part.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The B horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 3. It is clay or silty clay. The C horizon has hue of 10YR, value of 5, and chroma of 3 or 4. It is silty clay or clay.

## Nineveh series

The Nineveh series consists of deep, well drained soils formed in glacial outwash on terraces. Permeability is moderate in the solum and very rapid in the substratum. Slope is 0 to 2 percent.

Nineveh soils are commonly adjacent to Eldean and Westland soils and are similar to Eldean, Fox, and Ockley soils and the Wea Variant. Eldean, Fox, and Ockley soils are slightly higher on the landscape than Nineveh soils. They do not have a mollic epipedon. The Wea Variant has a thicker solum than Nineveh soils and is moderately fine textured in the lower part of the solum, below a depth of about 40 inches. Westland soils, which are in low lying areas, are wetter than Nineveh soils and have gray colors in the subsoil.

Typical pedon of Nineveh silt loam, 0 to 2 percent slopes, in Monroe Township, about 1 1/2 miles east-southeast of West Liberty, SW1/4SE1/4 sec. 21, R. 13, T. 5, about 160 feet south of Township Road 175, and 6,600 feet southeast of the intersection of U.S. Route 68 and State Route 245:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam; moderate fine granular structure; friable; many roots; 5 percent gravel; neutral; abrupt smooth boundary.

A12—9 to 16 inches; very dark grayish brown (10YR 3/2) silt loam; moderate fine subangular blocky structure; friable; common roots; continuous very dark brown (10YR 2/2) coatings on faces of peds; 5 percent gravel; neutral; clear wavy boundary.

B21t—16 to 20 inches; dark brown (7.5YR 4/4) silty clay loam; moderate medium subangular blocky structure; firm; common roots; faces of peds coated very dark grayish brown (10YR 3/2); thin patchy clay films on faces of peds; 10 percent gravel; neutral; clear wavy boundary.

B22t—20 to 26 inches; dark brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; common roots; thin patchy very dark grayish brown (10YR 3/2) clay films on faces of peds; about 12 percent gravel; neutral; clear wavy boundary.

B23t—26 to 31 inches; dark brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; common roots; thin patchy very dark grayish brown (10YR 3/2) clay films on faces of peds; about 12 percent gravel; mildly alkaline; clear wavy boundary.

B3—31 to 37 inches; dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) gravelly loam; weak medium subangular blocky structure; firm; thin very patchy very dark grayish brown (10YR 3/2) clay films on faces of peds; 35 percent gravel; slight effervescence; mildly alkaline; clear wavy boundary.

C—37 to 60 inches; yellowish brown (10YR 5/4) very gravelly sand; single grained; loose; 55 percent gravel; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 40 inches and the depth to free carbonates from 30 to 40 inches. The content of gravel ranges, by volume, from 0 to 10 percent in the A horizon and the upper part of the B horizon and from 5 to 35 percent in the lower part of the B horizon.

The B2t horizon has hue of 10YR or 7.5YR, value of 4, and chroma of 3 or 4. It is clay loam, silty clay loam, or gravelly clay loam. Reaction is slightly acid or neutral in the upper part of the B horizon 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.

## Ockley series

The Ockley series consists of deep, well drained soils formed in a thin layer of loess and loamy glacial drift over outwash on outwash terraces. Permeability is moderate in the upper part and very rapid in the substratum. Slope ranges from 0 to 6 percent.

Ockley soils are commonly adjacent to Eldean, Fox, Gallman, and Nineveh soils and the Wea Variant. Eldean, Fox, and Nineveh soils have a thinner solum and Gallman soils a thicker solum than Ockley soils. Also, Fox soils contain more clay in the subsoil. Nineveh soils and the Wea Variant have a mollic epipedon.

Typical pedon of Ockley silt loam, 0 to 2 percent slopes, in Monroe Township, about 2 miles west of Pickrelltown, 1,750 feet southeast of the intersection of County Road 29 and Township Road 166, and 1,990 feet east of Township Road 166:

Ap—0 to 10 inches; brown (10YR 4/3) silt loam; moderate fine granular structure; friable; many roots; medium acid; abrupt smooth boundary.

B1—10 to 15 inches; dark yellowish brown (10YR 4/4) silt loam; moderate fine subangular blocky structure; friable; many roots; strongly acid; clear wavy boundary.

IIB21t—15 to 25 inches; dark yellowish brown (10YR 4/4) clay loam; moderate fine subangular blocky structure; firm; common roots; thin patchy brown (7.5YR 4/4) clay films on faces of peds; very strongly acid; clear wavy boundary.

IIB22t—25 to 29 inches; brown (7.5YR 4/4) light clay; moderate medium subangular blocky structure; firm; thin patchy dark brown (7.5YR 4/3) clay films on faces of peds; very strongly acid; clear wavy boundary.

IIB23t—29 to 37 inches; dark brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; thin patchy clay films on faces of peds; 10 percent gravel; slightly acid; clear wavy boundary.

IIB3t—37 to 45 inches; dark brown (7.5YR 3/2) gravelly clay loam; moderate medium subangular blocky structure; firm; thin patchy clay films on faces of peds; 30 percent gravel; mildly alkaline; clear wavy boundary.

IIIC—45 to 60 inches; brown (10YR 5/3) very gravelly sand; single grained; loose; 60 percent gravel; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 40 to 60 inches. The content of coarse fragments ranges, by volume, from 0 to 15 percent in the upper part of the solum and from 18 to 40 percent in the lower part.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 5. The B2 horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is dominantly silty clay loam or clay loam in the upper part and clay loam, gravelly clay loam, or gravelly sandy clay loam in the lower part. In some pedons it has subhorizons of loam, sandy loam, sandy clay, or clay. The upper part of the B horizon ranges from medium acid to very strongly acid. The acidity tends to decrease with increasing depth. The IIB3 horizon has hue of 10YR or 7.5YR and value and chroma of 2 or 3.

## Parr series

The Parr series consists of deep, well drained soils formed in glacial till on ground moraines and end moraines. Permeability is moderate or moderately slow. Slope ranges from 1 to 4 percent.

Parr soils are commonly adjacent to Celina and Miamian soils and are similar to the Wea Variant. Celina and Miamian soils do not have a mollic epipedon. Also, Celina soils have gray mottles in the upper part of the argillic horizon. The Wea Variant formed in stratified outwash on terraces.

Typical pedon of Parr silt loam, 1 to 4 percent slopes, in Liberty Township, NW1/4NW1/4 sec. 34, R. 13, T. 5, about 2 miles northwest of West Liberty, 330 feet east of the intersection of State Route 508 and Township Road 32, and 100 feet south of State Route 508:

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) silt loam; moderate fine and medium granular structure; friable; many roots; about 2 percent gravel; neutral; abrupt smooth boundary.

A12—10 to 14 inches; very dark grayish brown (10YR 3/2) silt loam; moderate fine subangular blocky structure; friable; many roots; about 2 percent gravel; neutral; clear wavy boundary.

B1—14 to 17 inches; dark yellowish brown (10YR 4/4) silt loam; moderate medium subangular blocky structure; firm; common roots; thin patchy dark brown (10YR 3/3) coatings on faces of peds; about 2 percent gravel; slightly acid; clear wavy boundary.

B21t—17 to 22 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate medium subangular blocky structure; firm; common roots; thin patchy dark brown (10YR 3/3) clay films on faces of peds; about 2 percent gravel; slightly acid; clear wavy boundary.

B22t—22 to 31 inches; yellowish brown (10YR 5/4) clay loam; moderate medium subangular blocky structure; firm; common roots; thin patchy dark brown (10YR 3/3) clay films on faces of peds; about 7 percent gravel; slightly acid; clear wavy boundary.

B23t—31 to 39 inches; brown (10YR 5/3) clay loam; moderate medium subangular blocky structure; firm; thin patchy very dark grayish brown (10YR 3/2) clay films on faces of peds; about 7 percent gravel; mildly alkaline; clear wavy boundary.

C1—39 to 46 inches; brown (10YR 5/3) light clay loam; massive; firm; few very dark grayish brown (10YR 3/2) coatings in partings; 10 percent gravel; strong effervescence; moderately alkaline; clear wavy boundary.

C2—46 to 66 inches; yellowish brown (10YR 5/4) loam; massive; firm; 15 percent gravel; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 42 inches. The content of coarse fragments ranges, by volume, from 0 to 10 percent in the upper part of the solum and from 5 to 15 percent in the lower part.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 2. The B2 horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is dominantly clay loam or heavy loam, but it has subhorizons of silty clay loam. Reaction ranges from slightly acid to mildly alkaline. The C horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. It is mildly alkaline or moderately alkaline.

## Patton series

The Patton series consists of deep, poorly drained, moderately permeable soils formed in silty sediments in depressions in terraces and lake plains. Slope is 0 to 2 percent.

The Patton soils in Logan County contain slightly less clay in the 10- to 40-inch control section, are shallower to free carbonates, and have a thinner mollic epipedon

than is defined as the range for the Patton series. These differences, however, do not alter the use or behavior of the soils.

Patton soils are similar to Latty and Montgomery soils and the Patton Variant. Latty soils and the Patton Variant do not have a mollic epipedon. Latty and Montgomery soils contain more clay in the subsoil than Patton soils. The Patton Variant is calcareous throughout.

Typical pedon of Patton silt loam, in Union Township, SW1/4SW1/4 sec. 16, R. 13, T. 4, about 4 miles west of West Liberty, 530 feet north of the Champaign County line, and 4,290 feet west of the intersection of Township Roads 18 and 7:

Ap1—0 to 6 inches; black (10YR 2/1) silt loam; moderate medium granular structure; friable; common roots; about 2 percent hard black (10YR 2/1) concretions; mildly alkaline; clear wavy boundary.

Ap2—6 to 10 inches; black (10YR 2/1) silt loam; weak medium angular blocky structure; friable; common roots; about 2 percent hard black (10YR 2/1) concretions; mildly alkaline; abrupt smooth boundary.

B21g—10 to 15 inches; gray (10YR 5/1) silt loam; many fine distinct yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; friable; common roots; about 2 percent hard black (10YR 2/1) concretions; mildly alkaline; clear wavy boundary.

B22g—15 to 18 inches; gray (10YR 5/1) silt loam; many medium distinct yellowish brown (10YR 5/4) and dark yellowish brown (10YR 4/4) mottles; weak coarse prismatic structure parting to weak coarse subangular blocky; friable; common roots; about 2 percent very dark brown (10YR 2/2) concretions; mildly alkaline; clear wavy boundary.

B23g—18 to 21 inches; light brownish gray (10YR 6/2) silt loam; many medium distinct yellowish brown (10YR 5/4) mottles; weak coarse prismatic structure parting to weak coarse subangular blocky; friable; common light brownish gray (2.5Y 6/2) and very dark grayish brown (10YR 3/2) coatings on faces of peds; mildly alkaline; clear wavy boundary.

B3g—21 to 27 inches; light brownish gray (10YR 6/2) silt loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; weak coarse prismatic structure parting to weak coarse subangular blocky; friable; common dark yellowish brown (10YR 4/4) and very dark grayish brown (10YR 3/2) root channels; slight effervescence; mildly alkaline; clear wavy boundary.

C1g—27 to 34 inches; light brownish gray (2.5Y 6/2) silt loam; common medium distinct dark yellowish brown (10YR 4/4) and very dark gray (10YR 3/1) mottles; weak coarse subangular blocky structure; friable; common dark yellowish brown (10YR 4/4) and very dark grayish brown (10YR 3/2) root channels; strong effervescence; moderately alkaline; clear wavy boundary.

C2g—34 to 46 inches; light brownish gray (2.5Y 6/2) silt loam; many medium distinct dark yellowish brown (10YR 4/4) mottles; massive; friable; strong effervescence; moderately alkaline; clear wavy boundary.

C3g—46 to 62 inches; gray (10YR 6/1) silt loam; common medium distinct yellowish brown (10YR 5/4) mottles; massive; friable; strong effervescence; moderately alkaline; clear wavy boundary.

C4g—62 to 66 inches; gray (N 5/0) silt loam; common medium distinct yellowish brown (10YR 5/4) mottles; massive; friable; strong effervescence; moderately alkaline.

The solum ranges from 24 to 42 inches in thickness. It is slightly acid to mildly alkaline. The mollic epipedon extends into the upper part of the B horizon in some pedons.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The B horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is silt loam or silty clay loam.

## Patton Variant

The Patton Variant consists of deep, poorly drained, moderately permeable soils formed in silty sediments in depressions in lake plains. Slope is 0 to 2 percent.

The Patton Variant is similar to Latty, Montgomery, and other Patton soils. These similar soils contain more clay in the subsoil than the Patton Variant and are not calcareous throughout. Also, Montgomery soils and the other Patton soils have a mollic epipedon.

Typical pedon of Patton Variant silt loam, in Rush Creek Township, about 7 miles northeast of Bellefontaine, 1,850 feet south of the intersection of County Road 20 and Township Road 118, and 4,750 feet southeast of the intersection of Township Road 118 and County Road 9:

Ap—0 to 9 inches; very dark grayish brown (2.5Y 3/2) silt loam, light brownish gray (2.5Y 6/2) dry; moderate fine granular structure; friable; many roots; strong effervescence; moderately alkaline; abrupt smooth boundary.

B1g—9 to 13 inches; gray (10YR 5/1) silt loam; common medium distinct yellowish brown (10YR 5/4) and dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure parting to weak thick platy; friable; common roots; gray (10YR 5/1) coatings on faces of peds; common shell fragments; strong effervescence; moderately alkaline; clear wavy boundary.

B21g—13 to 24 inches; grayish brown (10YR 5/2) silt loam; common medium distinct yellowish brown (10YR 5/4) and dark brown (7.5YR 4/4) mottles; moderate coarse prismatic structure parting to weak medium subangular blocky; firm; common roots;

dark gray (10YR 4/1) coatings on faces of peds; common shell fragments; strong effervescence; moderately alkaline; clear wavy boundary.

B22g—24 to 38 inches; gray (10YR 5/1) silt loam; common medium distinct dark brown (7.5YR 4/4) and yellowish brown (10YR 5/4) mottles; moderate coarse prismatic structure; firm; common roots; olive (5Y 5/4) coatings on faces of peds; common shell fragments; strong effervescence; moderately alkaline; clear wavy boundary.

B3g—38 to 44 inches; gray (10YR 5/1) silt loam; common medium distinct dark brown (7.5YR 4/4) mottles; massive; firm; gray (5Y 5/1) coatings in partings; strong effervescence; moderately alkaline; clear wavy boundary.

Cg—44 to 60 inches; gray (5Y 5/1) silt loam; common medium distinct dark brown (7.5YR 4/4) mottles; massive; firm; about 5 percent shell fragments; strong effervescence; moderately alkaline; clear wavy boundary.

The thickness of the solum ranges from 20 to 45 inches. The content of coarse fragments is low, but in some pedons the substratum has horizons of gravelly sand or other gravelly material.

The Ap horizon has hue of 10YR or 2.5Y, value of 3, and chroma of 1 or 2. The B horizon has hue of 10YR, value of 5, and chroma of 1 or 2. It is silt loam or loam. The C horizon has hue of 10YR to 5Y, value of 5, and chroma of 1. It is silt loam or silt.

## Paulding series

The Paulding series consists of deep, very poorly drained, very slowly permeable soils. These soils formed in clayey sediments in depressions in lake plains and ground moraines. Slope is 0 to 2 percent.

Paulding soils are commonly adjacent to Nappanee and St. Clair soils and are similar to Latty soils. Nappanee and St. Clair soils are less gray in the subsoil than Paulding soils. They are on broad flats, knolls, ridgetops, and side slopes. Latty soils contain less clay in the subsoil and substratum than Paulding soils.

Typical pedon of Paulding clay, in Perry Township, about 2 1/4 miles southeast of East Liberty, 4,160 feet east of the intersection of County Road 154 and Township Road 156, and 120 feet south of Township Road 156:

Ap—0 to 11 inches; dark gray (10YR 4/1) clay, dark grayish brown (2.5Y 4/2) rubbed; moderate fine granular structure; firm; many roots; neutral; abrupt smooth boundary.

B21g—11 to 16 inches; gray (10YR 5/1) clay; common fine distinct yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; firm; many roots; thin patchy dark gray (10YR 4/1) coatings on faces of peds; neutral; clear wavy boundary.

B22g—16 to 30 inches; gray (10YR 5/1) clay; common fine distinct yellowish brown (10YR 5/4) and strong brown (7.5YR 5/6) mottles; moderate coarse angular blocky structure; firm; common roots; continuous gray coatings on faces of peds; mildly alkaline; clear wavy boundary.

B31g—30 to 44 inches; gray (5Y 5/1) clay; common fine distinct brown (10YR 4/3) mottles; weak coarse angular blocky structure; firm; patchy gray (10YR 5/1) coatings on faces of peds; mildly alkaline; clear wavy boundary.

B32g—44 to 51 inches; light gray (5Y 6/1) clay; common fine distinct yellowish brown (10YR 5/4) mottles; weak coarse angular blocky structure; firm; light brownish gray (2.5Y 6/2) coatings on partings; slight effervescence; mildly alkaline; clear wavy boundary.

C—51 to 67 inches; dark yellowish brown (10YR 4/4) clay; common medium distinct grayish brown (10YR 5/2) mottles; massive; firm; about 2 percent gravel; strong effervescence; moderately alkaline.

The solum ranges from 38 to 53 inches in thickness. The depth to carbonates is about the same as or slightly less than the thickness of the solum.

The Ap horizon has hue of 10YR, value of 4, and chroma of 1 or 2. It is slightly acid or neutral. The B2 horizon has hue of 10YR, 2.5Y, or N; value of 4 or 5; and chroma of 0 or 1. It is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part. The B3 horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4.

## Pewamo series

The Pewamo series consists of deep, very poorly drained, moderately slowly permeable soils formed in glacial till on till plains. Slope is 0 to 2 percent.

Pewamo soils are commonly adjacent to Blount and Glynwood soils and are similar to Brookston and Wetzel soils. Blount, Glynwood, and Wetzel soils are better drained than Pewamo soils and do not have a mollic epipedon. Also, Blount and Glynwood soils are less gray in the subsoil. Brookston soils contain less clay in the B and C horizons than Pewamo soils.

Typical pedon of Pewamo silty clay loam, in Pleasant Township, SE1/4NW1/4 sec. 10, T. 1 N., R. 8 E., about 3 miles north of Quincy, 2,510 feet northeast of the intersection of State Route 47 and County Road 34, and 1,100 feet north of State Route 47:

Ap—0 to 10 inches; very dark gray (10YR 3/1) silty clay loam; weak medium granular structure; firm; many roots; slightly acid; clear wavy boundary.

B1—10 to 12 inches; very dark gray (10YR 3/1) silty clay; common medium distinct dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) mot-

tles; strong medium angular blocky structure; firm; common roots; slightly acid; gradual wavy boundary.

B21tg—12 to 25 inches; dark gray (10YR 4/1) silty clay; many medium distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to moderate medium angular blocky; firm; thin patchy dark gray (10YR 4/1) clay films on faces of peds; slightly acid; gradual wavy boundary.

B22tg—25 to 38 inches; gray (10YR 5/1) silty clay; common medium distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to moderate medium and coarse angular blocky; firm; thin patchy gray (10YR 5/1) clay films on faces of peds; 5 percent gravel; slightly acid; clear wavy boundary.

B3g—38 to 50 inches; gray (10YR 5/1) silty clay; many medium distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; about 5 percent gravel; slightly acid; clear wavy boundary.

Cg—50 to 64 inches; gray (10YR 5/1) clay loam; many medium distinct yellowish brown (10YR 5/6) mottles; massive; firm; 5 percent gravel; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 30 to 50 inches. The content of coarse fragments is, by volume, less than 5 percent in the upper part of the solum and 2 to 10 percent in the lower part. The mollic epipedon is 10 to 14 inches thick.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is slightly acid or neutral. The B2 horizon has hue of 2.5Y or 10YR, value of 4 to 6, and chroma of 1 or 2. It is clay, silty clay, or heavy silty clay loam. It is slightly acid to mildly alkaline; the alkalinity increases with increasing depth. The C horizon is clay loam or silty clay loam. It is mildly alkaline or moderately alkaline.

## Rodman series

The Rodman series consists of deep, excessively drained soils formed in gravelly outwash on kames and dissected parts of outwash terraces. Permeability is moderately rapid in the surface layer and subsoil and very rapid in the substratum. Slope ranges from 18 to 50 percent.

The Rodman soils in Logan County have free carbonates in the mollic epipedon. As a result, they are not within the range defined for the Rodman series. This difference, however, does not alter the use or behavior of the soils.

Rodman soils are commonly adjacent to Casco and Eldean soils. These adjacent soils have a thicker solum than Rodman soils and contain more clay in the subsoil.

Typical pedon of Rodman gravelly loam, in an area of Rodman-Casco complex, 25 to 50 percent slopes, in Monroe Township, about 2 miles east of West Liberty, 980 feet northwest of the intersection of State Route 287 and County Road 1, and 660 feet west of County Road 1:

A11—0 to 4 inches; very dark grayish brown (10YR 3/2) gravelly loam; moderate fine granular structure; friable; many roots; 45 percent gravel; mildly alkaline; clear wavy boundary.

A12—4 to 8 inches; very dark grayish brown (10YR 3/2) gravelly loam; moderate medium granular structure; friable; many roots; 45 percent gravel; strong effervescence; moderately alkaline; clear wavy boundary.

B2—8 to 12 inches; dark brown (7.5YR 4/3) very gravelly sandy loam; moderate medium granular structure; friable; many roots; 60 percent gravel; strong effervescence; moderately alkaline; clear wavy boundary.

C—12 to 60 inches; yellowish brown (10YR 5/4) very gravelly sand; single grained; loose; 60 percent gravel; strong effervescence; moderately alkaline.

The solum is 8 to 15 inches thick. It is mildly alkaline or moderately alkaline throughout. The content of coarse fragments ranges, by volume, from 20 to 45 percent in the A horizon, from 20 to 60 percent in the B horizon, and from 40 to 60 percent in the C horizon.

The A horizon has hue of 10YR or 7.5YR, value of 3, and chroma of 1 to 3. The B2 horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 5. It is gravelly or very gravelly loam or sandy loam.

## St. Clair series

The St. Clair series consists of deep, moderately well drained soils formed in clayey glacial drift on ground moraines and end moraines. Permeability is slow or very slow. Slope ranges from 2 to 35 percent.

The St. Clair soils in Logan County have gray mottles in the upper 10 inches of the argillic horizon. As a result, they are not within the range defined for the St. Clair series. This difference, however, does not alter the use or behavior of the soils.

St. Clair soils are commonly adjacent to Nappanee and Paulding soils and are similar to Celina and Glynwood soils. Nappanee and Paulding soils are wetter than St. Clair soils and are more gray in the subsoil. Celina and Glynwood soils contain less clay in the subsoil and substratum than St. Clair soils. Also, Celina soils are of mixed mineralogy.

Typical pedon of St. Clair silt loam, 12 to 18 percent slopes, moderately eroded, in Zane Township, about 1 mile north of Middleburg, 4,820 feet north-northwest of the intersection of County Roads 153 and 152, and 790 feet west of County Road 152:

Ap1—0 to 3 inches; dark grayish brown (10YR 4/2) silt loam; moderate fine granular structure; friable; many roots; slightly acid; clear wavy boundary.

Ap2—3 to 7 inches; brown (10YR 5/3) silt loam; moderate fine subangular blocky structure; friable; many roots; common specks of very pale brown (10YR 7/3) material; medium acid; abrupt smooth boundary.

B21t—7 to 10 inches; yellowish brown (10YR 5/4) silty clay; common fine faint brown (10YR 5/3) mottles; moderate medium subangular blocky structure; firm; many roots; thin patchy brown (10YR 5/3) clay films on faces of peds; few fine distinct black (10YR 2/1) stains; medium acid; clear wavy boundary.

B22t—10 to 14 inches; yellowish brown (10YR 5/4) silty clay; common fine faint brown (10YR 5/3) mottles; moderate coarse subangular blocky structure; firm; common roots; thin patchy brown (10YR 5/3) clay films on faces of peds; few fine distinct black (10YR 2/1) stains; neutral; clear wavy boundary.

B23t—14 to 24 inches; yellowish brown (10YR 5/4) silty clay; common fine distinct grayish brown (10YR 5/2) mottles; moderate coarse subangular blocky structure; firm; thin patchy grayish brown (10YR 5/2) clay films on faces of peds; few fine distinct black (10YR 2/1) stains; less than 5 percent gravel; neutral; clear wavy boundary.

B3—24 to 28 inches; yellowish brown (10YR 5/4) silty clay; common fine distinct gray (10YR 5/1) mottles; weak medium subangular blocky structure; firm; thin very patchy gray (10YR 5/1) clay films on faces of peds; few fine black (10YR 2/1) concretions; less than 5 percent gravel; slight effervescence; mildly alkaline; clear wavy boundary.

C—28 to 60 inches; yellowish brown (10YR 5/4) silty clay; massive; firm; gray (10YR 5/1) coatings in partings; less than 5 percent gravel; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 30 inches and the depth to free carbonates from 20 to 25 inches. The content of coarse fragments is, by volume, less than 5 percent in the solum.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is medium acid to neutral. A B1 horizon of silty clay or silty clay loam is in some pedons. The B2 horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is clay or silty clay. It is medium acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 4. It is silty clay or clay.

## Shinrock series

The Shinrock series consists of deep, moderately well drained soils formed in lacustrine sediments on the dissected parts of lake plains. Permeability is moderately slow. Slope ranges from 2 to 12 percent.

Shinrock soils are commonly adjacent to Del Rey and Montgomery soils and are similar to Celina and Glynwood soils. Del Rey and Montgomery soils are wetter than Shinrock soils. Del Rey soils are on broad flats and convex knolls and Montgomery soils on flats and in depressions. Celina and Glynwood soils formed in glacial till on till plains.

Typical pedon of Shinrock silt loam, 6 to 12 percent slopes, in Pleasant Township, NE1/4SE1/4 sec. 31, R. 14, T. 3, about 2 miles east of DeGraff, 125 feet west of Township Road 33, and 2,110 feet north of the intersection of Township Roads 33 and 45:

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam; moderate medium granular structure; friable; many roots; medium acid; abrupt smooth boundary.

B1—9 to 13 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate fine subangular blocky structure; firm; many roots; common faint brown (10YR 4/3) coatings on faces of peds; few hard concretions; slightly acid; clear wavy boundary.

B21t—13 to 18 inches; dark yellowish brown (10YR 4/4) light silty clay; moderate medium angular blocky structure; firm; common roots; thin patchy dark yellowish brown (10YR 3/4) clay films on faces of peds; few hard concretions; slightly acid; clear wavy boundary.

B22t—18 to 21 inches; yellowish brown (10YR 5/4) light silty clay; common fine distinct light brownish gray (10YR 6/2) and pale brown (10YR 6/3) mottles; moderate medium angular blocky structure; firm; thin patchy dark brown (10YR 3/3) clay films on faces of peds; mildly alkaline; clear wavy boundary.

B3—21 to 30 inches; yellowish brown (10YR 5/4) light silty clay loam; weak medium angular blocky structure; firm; thin very patchy dark brown (10YR 3/3) clay films on faces of peds; slight effervescence; mildly alkaline; clear wavy boundary.

C—30 to 60 inches; yellowish brown (10YR 5/4) silty clay loam; massive; firm; thin light gray (10YR 7/1) calcium carbonate accumulations in partings; thin lenses of silt loam; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 36 inches and the depth to free carbonates from 15 to 30 inches. Reaction ranges from neutral to medium acid in the A horizon, from slightly acid to strongly acid in the upper part of the B horizon, and from medium acid to mildly alkaline in the lower part.

The Ap horizon is 6 to 9 inches thick. It has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The B2 horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is silty clay loam, light silty clay, or clay. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is dominantly silt loam or silty clay loam, but it has thin strata of fine sandy loam in some pedons.

## Shoals series

The Shoals series consists of deep, somewhat poorly drained, moderately permeable soils formed in alluvium on bottom land. Slope is 0 to 2 percent.

Shoals soils are commonly adjacent to Eel, Genesee, and Sloan soils. Eel and Genesee soils are slightly higher on the flood plain than Shoals soils and are better drained. Sloan soils are in depressions. They have a mollic epipedon.

Typical pedon of Shoals silt loam, in Bloomfield Township, SW1/4SW1/4 sec. 15, T. 5 S., R. 8 E., about 4 miles southeast of Russells Point, 2,270 feet southeast of the intersection of County Road 54 and Township Road 80, and 1,450 feet west of County Road 54:

Ap—0 to 12 inches; dark grayish brown (10YR 4/2) silt loam; weak medium granular structure; friable; many roots; mildly alkaline; abrupt smooth boundary.

C1—12 to 20 inches; dark grayish brown (10YR 4/2) heavy silt loam; common fine faint dark brown (10YR 4/3) mottles; moderate fine subangular blocky structure; friable; common roots; mildly alkaline; clear wavy boundary.

C2—20 to 26 inches; dark brown (10YR 4/3) heavy silt loam; many medium faint dark grayish brown (10YR 4/2) mottles; moderate medium subangular blocky structure; friable; common roots; mildly alkaline; clear wavy boundary.

C3—26 to 34 inches; dark grayish brown (10YR 4/2) heavy silt loam; common medium distinct yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; friable; common roots; mildly alkaline; clear wavy boundary.

C4—34 to 38 inches; grayish brown (10YR 5/2) heavy silt loam; common medium distinct yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; friable; few roots; mildly alkaline; clear wavy boundary.

C5—38 to 44 inches; yellowish brown (10YR 5/4) heavy silt loam; common medium distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; friable; mildly alkaline; clear wavy boundary.

C6—44 to 52 inches; grayish brown (10YR 5/2) heavy silt loam; common medium distinct yellowish brown (10YR 5/4) and common medium faint light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; friable; mildly alkaline; clear wavy boundary.

C7—52 to 60 inches; grayish brown (10YR 5/2) silt loam; common medium distinct yellowish brown (10YR 5/4) mottles; massive; friable; strong effervescence; moderately alkaline.

Reaction ranges from slightly acid to mildly alkaline within the upper 40 inches. The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2. To a depth of 40 inches, the C horizon commonly has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4.

## Sleeth series

The Sleeth series consists of deep, somewhat poorly drained soils formed in loamy outwash over gravel and sand on terraces and outwash plains. Permeability is moderate in the subsoil and very rapid in the substratum. Slope is 0 to 2 percent.

Sleeth soils are commonly adjacent to the Eldean and Westland soils and are similar to Haskins and Homer soils. Eldean soils are slightly higher on the landscape than Sleeth soils and are less gray in the subsoil. Haskins soils formed in outwash over glacial till or lacustrine material. Homer soils have a thinner solum than Sleeth soils. Also, the texture of the subsoil of Homer soils contrasts with the texture of the substratum. Westland soils are wetter than Sleeth soils and have a mollic epipedon.

Typical pedon of Sleeth silt loam, 0 to 2 percent slopes, in Richland Township, about 4 1/2 miles northwest of Belle Center, 330 feet west of State Route 117, and 2,110 feet northwest of the intersection of State Routes 117 and 273:

Ap1—0 to 10 inches; dark brown (10YR 4/3) silt loam; moderate fine granular structure; friable; common roots; few fine soft black (10YR 2/1) nodules; about 2 percent gravel; slightly acid; abrupt smooth boundary.

Ap2—10 to 13 inches; dark brown (10YR 4/3) silt loam; moderate medium granular structure; friable; common roots; dark grayish brown (10YR 4/2) coatings on faces of peds; 5 percent gravel; slightly acid; abrupt smooth boundary.

B21tg—13 to 17 inches; dark grayish brown (10YR 4/2) clay loam; many fine faint dark brown (10YR 4/3) mottles; moderate fine subangular blocky structure; firm; common roots; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; 5 percent gravel; slightly acid; clear wavy boundary.

B22tg—17 to 22 inches; dark grayish brown (10YR 4/2) clay loam; common fine faint dark brown (10YR 4/3) mottles; moderate medium subangular blocky structure; firm; common roots; thin patchy very dark grayish brown (10YR 3/2) clay films on faces of peds; continuous dark grayish brown (10YR 4/2) coatings on faces of peds; 5 percent gravel; slightly acid; clear wavy boundary.

B23tg—22 to 28 inches; dark gray (10YR 4/1) clay loam; many fine distinct dark brown (10YR 4/3) and common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; common roots; thin patchy very dark grayish brown (10YR 3/2) clay films on faces of peds; continuous dark grayish brown (10YR 4/2) coatings

on faces of peds; 10 percent gravel; slightly acid; clear wavy boundary.

B24t—28 to 33 inches; yellowish brown (10YR 5/4) clay loam; many medium distinct dark grayish brown (10YR 4/2) and yellowish brown (10YR 5/6) mottles; moderate medium angular blocky structure; firm; common roots; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; 10 percent gravel; neutral; clear wavy boundary.

IIB31tg—33 to 39 inches; grayish brown (10YR 5/2) gravelly loam; many medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; common roots; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; 25 percent gravel; slight effervescence; mildly alkaline; clear wavy boundary.

IIB32—39 to 45 inches; dark yellowish brown (10YR 4/4) gravelly loam; common medium distinct very dark gray (10YR 3/1) and dark grayish brown (10YR 4/2) and common medium faint yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; common light gray (10YR 7/2) weathered limestone pebbles; 30 percent gravel; slight effervescence; mildly alkaline; clear wavy boundary.

IIC1—45 to 51 inches; brown (10YR 5/3) very gravelly coarse sandy loam; single grained; loose; 65 percent gravel; strong effervescence; moderately alkaline; clear wavy boundary.

IIC2—51 to 57 inches; dark grayish brown (10YR 4/2) very gravelly loamy coarse sand; single grained; loose; 50 percent gravel; strong effervescence; moderately alkaline; clear wavy boundary.

IIC3—57 to 63 inches; gray (10YR 5/1) very gravelly coarse sand; single grained; loose; 65 percent gravel; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 40 to 60 inches and the depth to free carbonates from 35 to 50 inches. The content of coarse fragments ranges, by volume, from 2 to 10 percent in the upper part of the solum and from 10 to 30 percent in the lower part.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The B2 and B3 horizons have hue of 10YR, value of 4 or 5, and chroma of 1 to 4. The upper part of the B2 horizon is dominantly clay loam. The lower part of the B2 horizon and the B3 horizon are gravelly clay loam, clay loam, or gravelly loam. The B horizon is medium acid or slightly acid in the upper part and neutral or mildly alkaline in the lower part. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 1 to 3. It is gravelly or very gravelly sandy loam, loamy sand, or sand.

## Sloan series

The Sloan series consists of deep, very poorly drained soils formed in recent alluvium on flood plains. Permeability is moderate or moderately slow. Slope is 0 to 2 percent.

Sloan soils are commonly adjacent to Eel, Genesee, and Shoals soils. These adjacent soils are slightly higher on the flood plain than Sloan soils and are better drained.

Typical pedon of Sloan silt loam, in Pleasant Township, SE1/4SW1/4 sec. 2, R. 14, T. 2, about 1 mile north of DeGraff, 265 feet north of Township Road 43, and 2,110 feet northeast of the intersection of Township Road 43 and State Route 235:

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam; moderate fine granular structure; friable; many roots; slight effervescence; mildly alkaline; clear smooth boundary.

A12—6 to 10 inches; very dark grayish brown (10YR 3/2) heavy silt loam; moderate medium granular structure; friable; common roots; slight effervescence; mildly alkaline; clear smooth boundary.

A13—10 to 18 inches; very dark gray (10YR 3/1) silt loam; moderate fine subangular blocky structure; friable; common roots; continuous black (10YR 2/1) coatings on faces of peds; mildly alkaline; clear smooth boundary.

A14—18 to 22 inches; very dark grayish brown (10YR 3/2) silty clay loam; common medium faint dark brown (10YR 3/3) and many medium faint dark gray (10YR 4/1) mottles; moderate fine subangular blocky structure; friable; common roots; continuous black (10YR 2/1) coatings; mildly alkaline; clear wavy boundary.

B21g—22 to 27 inches; gray (10YR 5/1) silty clay loam; many medium distinct yellowish brown (10YR 5/4) and many medium faint dark gray (10YR 4/1) mottles; moderate medium subangular blocky structure; firm; common roots; about 3 percent gravel; mildly alkaline; clear wavy boundary.

B22g—27 to 33 inches; gray (10YR 5/1) silty clay loam; common medium distinct brown (10YR 4/3) mottles; weak medium subangular blocky structure; firm; about 3 percent gravel; mildly alkaline; clear wavy boundary.

B3—33 to 47 inches; yellowish brown (10YR 5/4) light silty clay loam; many medium distinct grayish brown (10YR 5/2) and very dark grayish brown (10YR 3/2) mottles; weak medium subangular blocky structure; firm; 5 percent gravel; slight effervescence; mildly alkaline; clear wavy boundary.

C1g—47 to 53 inches; gray (10YR 5/1) light silty clay loam; common medium distinct brown (10YR 4/3) mottles; massive; firm; 10 percent gravel; strong effervescence; moderately alkaline; clear wavy boundary.

IIC2g—53 to 66 inches; gray (10YR 5/1) sandy loam; single grained; loose; 10 percent gravel; strong effervescence; moderately alkaline.

Reaction ranges from slightly acid to mildly alkaline in the A horizon and in the upper part of the B horizon and is neutral or mildly alkaline in the lower part of the B horizon.

The Ap and A1 horizons have hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The B2 horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 or 2. It is silty clay loam, clay loam, or loam. The C horizon is stratified. It varies in texture.

## Wallkill series

The Wallkill series consists of deep, very poorly drained soils formed in alluvium overlying organic material in depressions in terraces and uplands. Permeability is moderate in the alluvium and moderately rapid or rapid in the organic material. Slope is 0 to 2 percent.

Wallkill soils are similar to Algiers and Carlisle soils. Algiers soils formed in alluvium over a buried mineral soil. Carlisle soils formed in organic material.

Typical pedon of Wallkill silt loam, in Union Township, SW1/4NW1/4 sec. 18, R. 13, T. 4, about 4 miles east of DeGraff, 825 feet south of Township Road 45, and 5,380 feet west of County Road 18:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; weak fine granular structure; friable; many roots; mildly alkaline; abrupt smooth boundary.

Bg—8 to 16 inches; gray (10YR 5/1) silt loam; common fine distinct dark grayish brown (10YR 4/2) mottles; weak fine angular blocky structure; friable; common roots; mildly alkaline; clear wavy boundary.

Cg—16 to 20 inches; gray (10YR 5/1) silt loam; common fine distinct brown (10YR 4/3) mottles; massive; friable; mildly alkaline; clear wavy boundary.

IIOa1—20 to 24 inches; black (10YR 2/1) sapric material; about 10 percent fiber, none rubbed; weak fine granular structure; friable; common pockets of grayish brown (10YR 5/2) silt loam; mildly alkaline; clear wavy boundary.

IIOa2—24 to 60 inches; black (N 2/0) sapric material; about 15 percent fiber, 5 percent rubbed; massive; friable; thin layers of very dark grayish brown (10YR 3/2) hemic material; mildly alkaline.

The thickness of the alluvium ranges from 16 to 40 inches. The organic layer beneath the mineral soil is more than 20 inches thick.

The Ap horizon has hue of 10YR or 2.5Y, value of 3 or 4, and chroma of 1 or 2. The Bg horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 or 2. It is dominantly silt loam, but it has thin layers of loam or silty clay loam in some pedons. The O horizon has hue of 10YR or N, value of 2 or 3, and chroma of 0 to 2. It is neutral or mildly alkaline.

## Wea Variant

The Wea Variant consists of deep, well drained, moderately permeable soils formed in outwash on terraces. Slope is 0 to 2 percent.

The Wea Variant is commonly adjacent to Eldean, Gallman, and Sleeth soils and is similar to Nineveh soils. Eldean and Gallman soils generally are slightly higher on the landscape than these Wea soils. They do not have a mollic epipedon. Eldean and Nineveh soils have a thinner solum than the Wea soils. Nineveh soils have stratified sand and gravel at a depth of 24 to 40 inches. Sleeth soils have gray colors in the subsoil.

Typical pedon of Wea Variant silt loam, 0 to 2 percent slopes, in Jefferson Township, about 2 1/4 miles southeast of Zanesfield, 3,330 feet southeast of the intersection of County Road 153 and Township Road 145, and 200 feet south of County Road 153:

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam; moderate fine granular structure; friable; common roots; 5 percent gravel; neutral; abrupt smooth boundary.

A12—7 to 14 inches; very dark grayish brown (10YR 3/2) silt loam; moderate fine subangular blocky structure; friable; common roots; thin patchy very dark brown (10YR 2/2) coatings on faces of peds; 10 percent gravel; neutral; clear wavy boundary.

B21t—14 to 23 inches; dark brown (10YR 4/3) shaly silty clay loam; moderate fine subangular blocky structure; friable; common roots; thin patchy very dark grayish brown (10YR 3/2) clay films on faces of peds; 25 percent coarse fragments, mostly of shale; neutral; clear wavy boundary.

B22t—23 to 29 inches; dark yellowish brown (10YR 3/4) shaly clay loam; moderate fine subangular blocky structure; firm; common roots; thin patchy dark brown (10YR 3/3) clay films on faces of peds; 30 percent coarse fragments, mostly of shale; neutral; clear wavy boundary.

B23t—29 to 45 inches; dark yellowish brown (10YR 3/4) very shaly light clay; moderate medium subangular blocky structure; firm; common roots; thin patchy dark brown (10YR 3/3) clay films on faces of peds; 50 percent coarse fragments, mostly of shale; neutral; clear wavy boundary.

B31t—45 to 63 inches; dark yellowish brown (10YR 3/4) sandy clay loam; few fine distinct pale brown (10YR 6/3) mottles; weak coarse subangular blocky structure; firm; thin patchy clay films on faces of peds; 10 percent coarse fragments, mostly of shale; neutral.

The thickness of the solum and the depth to carbonates are more than 5 feet. Reaction ranges from slightly acid to neutral throughout the soil. The content of coarse fragments ranges, by volume, from 5 to 35 percent in the upper part of the B2t horizon and from 10 to 50 percent in the lower part.

The Ap and A1 horizons have hue of 10YR, value of 3, and chroma of 2 or 3. The thickness of the Ap horizon combined with that of the A12 horizon is 11 to 14 inches. The B2t horizon has hue of 10YR and value and chroma of 3 or 4. It is silty clay loam, clay loam, or clay or the gravelly, shaly, or very shaly analogs of these textures. The B3 horizon has colors similar to those of the B2t horizon. It is sandy clay loam or clay loam or the gravelly, shaly, or very shaly analogs of these textures.

## Weikert series

The Weikert series consists of shallow, well drained soils formed in weathered residuum of shale on uplands. Permeability is moderately rapid. Slope ranges from 35 to 70 percent.

Weikert soils are commonly adjacent to the Berks soils and the Miamian Variant. These adjacent soils are moderately deep to shale bedrock. Also, the Miamian Variant has a higher base status and clay content than Weikert soils and contains fewer shale fragments throughout.

Typical pedon of Weikert shaly silt loam, 35 to 70 percent slopes, in Jefferson Township, about 6 miles east of Bellefontaine, 6,270 feet west of the intersection of County Road 2 and Township Road 129, and 3,565 feet north of County Road 2:

A1—0 to 2 inches; very dark gray (10YR 3/1) shaly silt loam; moderate very fine granular structure; friable; many roots; 25 percent shale fragments; medium acid; clear wavy boundary.

A2—2 to 6 inches; dark grayish brown (10YR 4/2) shaly silt loam; moderate fine granular structure; friable; many roots; 35 percent shale fragments; medium acid; clear wavy boundary.

B21—6 to 10 inches; dark brown (10YR 4/3) very shaly silt loam; moderate fine subangular blocky structure; friable; many roots; 50 percent shale fragments; strongly acid; clear wavy boundary.

B22—10 to 13 inches; brown (10YR 4/3) very shaly silt loam; moderate fine subangular blocky structure; friable; common roots; 50 percent shale fragments; very strongly acid; clear wavy boundary.

B23—13 to 18 inches; brown (10YR 5/3) shaly silt loam; weak fine subangular blocky structure; friable; common roots; 30 percent shale fragments; very strongly acid; clear wavy boundary.

R—18 to 60 inches; very dark brown (10YR 2/2) shale bedrock; partly fragmented.

The thickness of the solum, or the depth to bedrock, ranges from 10 to 20 inches. The content of coarse fragments of shale ranges, by volume, from 20 to 50 percent in the Ap horizon and from 30 to 65 percent in the B horizon.

The A1 horizon is 2 or 3 inches thick. It has hue of 10YR, value of 3 or 4, and chroma of 1 or 2. It is very strongly acid to medium acid. The A2 horizon is medium acid to very strongly acid. The B horizon has hue of 10YR, value of 4 to 6, and chroma of 3 or 4. It is medium acid to very strongly acid.

## Westland series

The Westland series consists of deep, very poorly drained soils formed in loamy outwash on terraces and valley trains. Permeability is slow in the subsoil. It typically is very rapid in the substratum, but the clay substratum phase has very slowly permeable lacustrine sediments below a depth of about 52 inches. Slope is 0 to 2 percent.

Westland soils are commonly adjacent to Eldean, Homer, Lippincott, and Sleeth soils and are similar to Lippincott soils. Eldean, Homer, and Sleeth soils are slightly higher on the landscape than Westland soils and are better drained. They do not have a mollic epipedon. Lippincott soils have a thinner solum than Westland soils.

Typical pedon of Westland silty clay loam, in Liberty Township, NW1/4NE1/4 sec. 33, R. 13, T. 5, about three-fourths of a mile northwest of West Liberty, 825 feet east of Township Road 192, and 2,510 feet northeast of the intersection of Township Roads 192 and 193:

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam; moderate fine and medium granular structure; friable; many roots; neutral; abrupt smooth boundary.

A12—9 to 12 inches; very dark gray (10YR 3/1) silty clay loam; moderate fine subangular blocky structure; friable; many roots; common black (10YR 2/1) coatings; neutral; clear wavy boundary.

B21tg—12 to 17 inches; dark grayish brown (10YR 4/2) clay loam; many medium distinct yellowish brown (10YR 5/4) mottles; moderate fine subangular blocky structure; firm; common roots; thin patchy gray (10YR 5/1) clay films on faces of peds; about 2 percent gravel; neutral; clear wavy boundary.

B22tg—17 to 22 inches; dark gray (10YR 4/1) clay loam; common medium distinct yellowish brown (10YR 5/4, 5/6) mottles; moderate medium subangular blocky structure; firm; common roots; thin patchy clay films on faces of peds; about 2 percent gravel; neutral; clear wavy boundary.

B23tg—22 to 30 inches; gray (10YR 5/1) clay loam; many medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; common roots; thin patchy clay films on faces of peds; few black (10YR 2/1) stains; about 5 percent gravel; neutral; clear wavy boundary.

B31tg—30 to 36 inches; gray (10YR 5/1) clay loam; many medium distinct yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; firm; common roots; thin patchy clay films on faces of peds; 5 percent gravel; few dark gray (10YR 4/1) krotovinas; mildly alkaline; clear wavy boundary.

B32g—36 to 45 inches; gray (10YR 5/1) silty clay loam; common medium distinct yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; firm; 5 percent gravel; slight effervescence; moderately alkaline; clear wavy boundary.

IIB33g—45 to 50 inches; grayish brown (10YR 5/2) gravelly silty clay loam; common medium distinct yellowish brown (10YR 5/4) mottles; weak coarse subangular blocky structure; firm; 20 percent gravel; slight effervescence; moderately alkaline; clear wavy boundary.

IIC—50 to 60 inches; brown (10YR 5/3) gravelly sand; single grained; loose; 20 percent gravel; strong effervescence; moderately alkaline.

The solum ranges from 40 to 60 inches in thickness. The Ap and A1 horizons have hue of 10YR, value of 2 or 3, and chroma of 1 or 2. Reaction is slightly acid or neutral.

The B2 horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2. It is dominantly clay loam or gravelly clay loam, but in some pedons it has subhorizons of sandy clay loam or silty clay loam. The gravel content ranges from 2 to 30 percent. This horizon is slightly acid or neutral. The B3 horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2. It is silty clay loam, clay loam, or loam or the gravelly analogs of these textures. The gravel content ranges from 5 to 20 percent. Reaction is mildly alkaline or moderately alkaline.

The C horizon has hue of 2.5Y or 10YR, value of 4 to 6, and chroma of 1 to 3. It is typically gravelly sand, gravelly loamy sand, or loamy coarse sand, but the clay substratum phase has subhorizons of coarse sandy loam and silty clay.

## Wetzel series

The Wetzel series consists of deep, poorly drained, moderately slowly or slowly permeable soils formed in glacial till that in places is mantled with lacustrine sediments. These soils are on ground moraines and end moraines. Slope is 0 to 2 percent.

Wetzel soils are commonly adjacent to Blount, Glynwood, and Pewamo soils and are similar to Latty and Paulding soils. Blount and Glynwood soils are better drained than Wetzel soils and are less gray in the subsoil. Brookston and Pewamo soils are wetter than Wetzel soils and have a mollic epipedon. Latty and Paulding soils formed in lake-laid sediments. Also, Paulding soils contain more clay in the solum than Wetzel soils.

Typical pedon of Wetzel silty clay loam, in Bokes Creek Township, about 2 1/2 miles north of West Mansfield, 630 feet southeast of the intersection of County Roads 26 and 142, and 600 feet east of County Road 142:

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) silty clay loam; moderate fine subangular blocky structure; firm; many roots; slightly acid; abrupt smooth boundary.

B1g—10 to 17 inches; gray (10YR 5/1) clay; common medium distinct dark yellowish brown (10YR 4/4) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; common roots; thin patchy gray (10YR 5/1) coatings on faces of peds; neutral; clear wavy boundary.

B21tg—17 to 28 inches; grayish brown (10YR 5/2) clay; common medium distinct yellowish brown (10YR 5/4, 5/6) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; common roots; thin patchy grayish brown (10YR 5/2) clay films on faces of peds; about 2 percent gravel; mildly alkaline; clear wavy boundary.

B22tg—28 to 37 inches; gray (10YR 5/1) clay; common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate coarse angular blocky structure; firm; thin patchy gray (10YR 6/1) clay films on faces of peds; few distinct black (10YR 2/1) stains; 5 percent gravel; mildly alkaline; clear wavy boundary.

B3g—37 to 44 inches; gray (10YR 5/1) clay; common medium distinct yellowish brown (10YR 5/4) mottles; weak coarse angular blocky structure; firm; thin patchy gray (10YR 5/1) pressure films on faces of peds; 5 percent gravel; mildly alkaline; clear wavy boundary.

Cg—44 to 60 inches; gray (10YR 5/1) clay loam; many medium distinct dark yellowish brown (10YR 4/4) mottles; massive; firm; 5 percent gravel; strong effervescence; moderately alkaline.

The thickness of solum ranges from 36 to 52 inches and the depth to carbonates from 32 to 55 inches. The content of coarse fragments is dominantly 2 to 5 percent throughout the soil. Reaction is neutral or slightly acid in the Ap horizon, slightly acid to mildly alkaline in the upper part of the B horizon, and neutral to moderately alkaline in the lower part.

The Ap horizon has hue of 10YR, value of 4, and chroma of 1 or 2. The B horizon has hue of 10YR, 2.5Y, or N; value of 4 or 5; and chroma of 0 to 2. It is dominantly clay or silty clay and is mildly alkaline or moderately alkaline.

## Willette series

The Willette series consists of deep, very poorly drained soils formed in deposits of organic material that are 16 to 50 inches deep over clayey or silty material. These soils are on till plains, lake plains, and outwash plains. Permeability is moderately slow to moderately rapid in the organic deposit and slow in the clayey or silty material. Slope is 0 to 2 percent.

Willette soils are commonly near Carlisle, Edwards, Linwood, Martisco, and Muskego soils. Carlisle soils formed in an organic deposit that is thicker than that in which Willette soils formed. Edwards and Martisco soils

formed in organic material over marl. Linwood soils have a loamy substratum at a depth of 16 to 51 inches. Muskego soils formed in an organic deposit over sedimentary peat.

Typical pedon of Willette muck, in Perry Township, about half a mile southeast of East Liberty, 660 feet south-southwest of the intersection of County Roads 155 and 154, and 690 feet west of County Road 154:

Oap—0 to 7 inches; black (10YR 2/1) broken face and rubbed sapric material; less than 5 percent fiber rubbed; moderate fine granular structure; very friable; many roots; medium acid; clear wavy boundary.

Oa2—7 to 10 inches; very dark brown (10YR 2/2) broken face, black (10YR 2/1) rubbed sapric material; about 10 percent fiber, less than 5 percent rubbed; weak coarse angular blocky structure; very friable; many roots; slightly acid; clear wavy boundary.

Oa3—10 to 15 inches; very dark brown (10YR 2/2) broken face and rubbed sapric material; about 30 percent fiber, less than 5 percent rubbed; weak coarse angular blocky structure; friable; common roots; about 5 percent woody fragments; neutral; clear wavy boundary.

Oa4—15 to 21 inches; very dark gray (10YR 3/1) broken face, very dark grayish brown (10YR 3/2) rubbed sapric material; about 30 percent fiber, less than 5 percent rubbed; massive; friable; common roots; about 10 percent woody fragments; neutral; clear smooth boundary.

Oa5—21 to 25 inches; very dark brown (10YR 2/2) broken face, very dark grayish brown (10YR 3/2) rubbed sapric material; about 30 percent fiber, less than 5 percent rubbed; massive; friable; mildly alkaline; clear smooth boundary.

Oa6—25 to 34 inches; very dark grayish brown (10YR 3/2) broken face and rubbed sapric material; about 20 percent fiber, less than 5 percent rubbed; massive; friable; about 10 percent woody fragments three-fourths of an inch in diameter; mildly alkaline; clear smooth boundary.

IIC1g—34 to 66 inches; gray (N 5/0) silty clay; common medium distinct olive (5Y 5/3) mottles; massive; firm; mildly alkaline; clear wavy boundary.

IIC2g—66 to 70 inches; dark grayish brown (10YR 4/2) silty clay; massive; firm; dark gray (10YR 4/1) coatings in partings; mildly alkaline.

Depth to the clayey IIC horizon ranges from 16 to 50 inches. The solum ranges from medium acid to mildly alkaline throughout.

The surface tier has hue of 10YR or N, value of 2, and chroma of 0 to 2, broken face and rubbed. The subsurface and bottom tiers have hue of N or of 10YR to 5YR, value of 2 or 3, and chroma of 1 to 3, broken face and rubbed. Overlying the IIC horizon in some pedons is a layer of coprogenous earth as much as 5 inches thick. The C horizon has hue of N or of 5Y to 5YR, value of 4 to 6, and chroma of 0 to 2. It ranges from silty clay loam to clay and averages more than 35 percent clay. It is mildly alkaline or moderately alkaline.

## Classification of the soils

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Readers interested in further details about the system should refer to "Soil taxonomy" (*12*).

The system of classification has six categories. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. In this system the classification is based on the different soil properties that can be observed in the field or those that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or of factors that affect soil genesis. In table 18, the soils of the survey area are classified according to the system. Categories of the system are discussed in the following paragraphs.

ORDER. Ten soil orders are recognized as classes in the system. The properties used to differentiate among orders are those that reflect the kind and degree of dominant soil-forming processes that have taken place. Each order is identified by a word ending in *sol*. An example is Alfisol.

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

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of expression of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and a prefix that suggests something about the properties of the soil. An example is Hapludalfs (*Hapl*, meaning simple horizons, plus *udalf*, the suborder of Alfisols that have a udic moisture regime).

SUBGROUP. Each great group may be divided into three subgroups: the central (typic) concept of the great groups, which is not necessarily the most extensive subgroup; the intergrades, or transitional forms to other orders, suborders, or great groups; and the extragrades, which have some properties that are representative of the great groups but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that is

thought to typify the great group. An example is Typic Hapludalfs.

FAMILY. Families are established within a subgroup on the basis of similar physical and chemical properties that affect management. Among the properties considered in horizons of major biological activity below plow depth are particle-size distribution, mineral content, temperature regime, thickness of the soil penetrable by roots, consistence, moisture equivalent, soil slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for the soil properties used as family differentiae. An example is fine-loamy, mixed, mesic Typic Hapludalfs.

SERIES. The series consists of soils that formed in a particular kind of material and have horizons that, except for texture of the surface soil or of the underlying substratum, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineral and chemical composition.

# Formation of the soils

This section describes the major factors of soil formation, shows how these factors have affected the soils in Logan County, and explains some of the processes in soil formation.

## Factors of soil formation

Soil-forming processes act on deposited or accumulated geologic material. The major factors in soil formation are parent material, climate, relief, living organisms, and time.

Climate and living organisms, particularly vegetation, are the active forces of soil formation. Their effect on the parent material is modified by relief and by the length of time that the parent material has been acted upon. The relative importance of each factor differs from place to place. In some areas one factor dominates and determines most of the soil properties, but normally the interaction of all five factors determines what kind of soil forms in any given place.

### Parent material

The soils of Logan County formed in several kinds of parent material: glacial till, glacial outwash, and loess, or combinations of these materials; lacustrine deposits; recent alluvium; and accumulated organic material.

Glacial till, which occurs as extensive glacial deposits, is the most extensive parent material in the county. The upland soils formed dominantly in glacial till. As much as 14 inches of loess caps the till in some areas. In these areas the upper part of the soil formed in loess. Blount, Glynwood, Celina, and Crosby soils are partly capped by loess. The till is fairly homogeneous and uniform in texture, and the soils formed in this parent material have a moderately fine textured or fine textured subsoil.

Outwash of sand and gravel was deposited in the county by melt water along the glacial streams. Much of this generally well sorted coarse material was covered by finer textured loamy outwash. Eldean and Lippincott soils, for example, formed in this material. Eldean soils are reddish brown because drainage is good. Lippincott soils are dominantly gray because the water table is high and aeration is poor.

Lacustrine material, or lake bottom sediments, is moderately extensive in the county. The silty and clayey strata of the parent material in these areas are evident in the fine textured, plastic subsoil of Latty and Montgomery soils.

Alluvial material, which is deposited by floodwater, is the youngest parent material in the county. It is still accumulating as overflowing streams deposit fresh sediments. The sediments are from the surface layer of the higher lying soils in the county and from exposures of glacial till. Genesee soils, which are deep, fertile, and mildly alkaline or moderately alkaline, formed in alluvial material.

Accumulated organic material occurs in a few scattered areas. It consists mainly of decomposed remains of trees, sedges, and grasses that have accumulated in potholes and in drainageways where the water table is high and where seepage water has kept the area permanently wet. This material is strongly acid to moderately alkaline. Carlisle soils formed in this material.

### Climate

The climate in Logan County is uniform enough that it has not greatly contributed to differences among the soils. It has favored physical change and chemical weathering of parent material and biological activity.

Rainfall and temperature have promoted plant growth and the accumulation of organic matter in all the soils. Rainfall has been adequate for percolating water to leach carbonates to a moderate depth in many soils, for example, in Glynwood, Celina, and Blount soils. The wetting and drying cycles related to the frequency of rainfall have favored the translocation of clay minerals and the formation of soil structure in such soils as Glynwood, Miamian, and Eldean.

Temperature variations have favored physical change and chemical weathering of parent material. Freezing and thawing have aided in the formation of soil structure, and warm temperatures in summer have favored chemical reactions in the weathering of primary minerals.

More information about climate in Logan County is given under the heading "General nature of the county."

### Relief

Soils formed in the same kind of parent material can differ because relief has affected their formation. Glynwood, Blount, and Pewamo soils, for example, all formed

in glacial till. The moderately well drained Glynwood soils, which have a moderately thick solum, are gently sloping. They generally formed in areas where the slope is neither so steep that excessive erosion occurs nor so nearly level that runoff is prevented. The somewhat poorly drained Blount soils are nearly level and gently sloping. They formed in areas where runoff is slow or medium. The very poorly drained, dark colored Pewamo soils, which are near the Blount soils, are nearly level. They formed in the swales where some organic residue accumulates because the water table is high most of the year.

### Living organisms

At the time Logan County was settled, the vegetation was chiefly hardwood forest, dominantly beech, maple, oak, hickory, and ash. Grassy clearings occurred on the well drained sites and the marshy openings in the poorly drained swales.

Soils that formed in forested areas are generally acid and moderate or low in natural fertility. Glynwood, Blount, and St. Clair soils are examples. The well drained, dark colored, less acid and more fertile Parr and Nineveh soils are in the grassy clearings. Very poorly drained, dark colored, fertile soils, such as Pewamo, Wetzel, and Brookston soils, are in the marshy swales.

As small animals, insects, worms, and roots channel the soil, they make it more permeable. Animals also mix the soil and contribute organic matter. Worm channels or casts are plentiful in the surface layer of Parr and Nineveh soils. Crawfish channels are prevalent in the very poorly drained Paulding, Lippincott, and Montgomery soils.

### Time

Time is needed for the other soil-forming factors to take effect. The age of a soil is indicated, to some extent, by the degree of profile formation. In many places factors other than time have been responsible for most of the differences in kind and distinctness of horizons in the different soils. If the parent material weathers slowly, the profile forms slowly. If slopes are steep and soil is removed almost as fast as it forms, no distinct horizons form.

Most soils in the county have well formed profiles. Examples are Glynwood, Blount, Celina, and Eldean soils. On the flood plains, deposits of fresh sediments periodically interrupt the soil-forming process. The Genesee and Eel soils on flood plains are examples of soils in which horizons are not strongly expressed.

## Processes of soil formation

Most of the soils in Logan County have a strongly expressed profile because the processes of soil formation have produced very distinct changes in the material in which the soils formed. These are the undulating to rolling soils in areas of deposited glacial till and on glacial outwash terraces along the major valleys. In contrast, the soils on flood plains differ only slightly from the parent material.

The processes of soil formation are (1) additions, (2) removals, (3) transfers, and (4) transformations. Some promote horizon differentiation, but others retard differentiation or obliterate differences.

The most prevalently added material in the soils in Logan County is organic matter. Soils that formed in areas where the plant cover is deep-rooted grasses or where a high water table has restricted decomposition of organic matter have a thick, dark colored surface layer. In this surface layer organic-matter content is high, structure is good, and base saturation exceeds 50 percent. Examples are Westland and Brookston soils. Some organic matter accumulates as a thin surface mat on most soils, but this material generally is obliterated by cultivation. Severe erosion can remove all evidence of this addition to the soil profile.

Leaching of carbonates from calcareous parent material is one of the most significant losses that precedes many other chemical changes in the solum. Most of the glacial till in Logan County has a high content of carbonates (25 to 45 percent). In most soils carbonates have been leached to a depth of 2 feet or more. As a result, the upper 2 feet is acid. Other minerals in the soil are subject to the same chemical weathering, but their resistance is higher and removal is slower. Following the removal of carbonates, alteration of such minerals as biotite and feldspar results in color changes within the profile. When free iron oxides are segregated by a fluctuating high water table, the result is the gray colors and the mottling in, for example, Brookston soils. Unless the water table is seasonally high within the profile, brownish colors that have stronger chroma or redder hue than those in the C horizon are typical.

Seasonal wetting and drying of the soil is largely responsible for the transfer of clay from the A horizon to the faces of peds in the B horizon. The fine clays are suspended in percolating water moving through the A horizon. They are then deposited on the faces of peds in the B horizon. This transfer of fine clay accounts for the patchy or nearly continuous clay films on the faces of peds in the B horizon of, for example, Glynwood, Miamian, and Celina soils.

Transformations of mineral compounds occur in most soils. The results of these transformations are most apparent if the formation of horizons is not affected by rapid erosion or by accumulation of material at the surface. As the primary silicate minerals are weathered chemically, secondary minerals, mainly those of the layer-lattice silicate clays, are produced. Most of these clays remain in the soil profile, but clay from the A horizon is transferred to horizons below.

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## Glossary

**Aeration, soil.** The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

**Aggregate, soil.** Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

**Alluvium.** Material, such as sand, silt, or clay, deposited on land by streams.

**Area reclaim.** An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

**Available water capacity (available moisture capacity).** The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

| | *Inches* |
|---|---|
| Very low | 0 to 3 |
| Low | 3 to 6 |
| Moderate | 6 to 9 |
| High | More than 9 |

**Base saturation.** The degree to which material having base exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the exchange capacity.

**Bedrock.** The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

**Bottom land.** The normal flood plain of a stream, subject to frequent flooding.

**Calcareous soil.** A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

**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.

**Channery soil.** A soil, that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a fragment.

**Clay.** As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay,

less than 45 percent sand, and less than 40 percent silt.

**Clay film.** A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coat, clay skin.

**Coarse fragments.** Mineral or rock particles up to 3 inches (2 millimeters to 7.5 centimeters) in diameter.

**Coarse textured (light 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.

**Colluvium.** Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the bases of steep slopes.

**Complex slope.** Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures is difficult.

**Complex, soil.** A map unit of two or more kinds of soil occurring in such an intricate pattern that they cannot be shown separately on a soil map at the selected scale of mapping and publication.

**Concretions.** Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

**Consistence, soil.** The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

*Loose.*—Noncoherent when dry or moist; does not hold together in a mass.

*Friable.*—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

*Firm.*—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

*Plastic.*—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

*Sticky.*—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

*Hard.*—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

*Soft.*—When dry, breaks into powder or individual grains under very slight pressure.

*Cemented.*—Hard; little affected by moistening.

**Contour stripcropping (or contour farming).** 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 40 or 80 inches (1 or 2 meters).

**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.** Unstable walls of cuts made by earth-moving equipment. The soil sloughs easily.

**Delta.** An alluvial deposit, commonly triangular in shape, formed largely beneath water and deposited at the mouth of a river or stream.

**Depth to rock.** Bedrock at a depth that adversely affects 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 for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

*Somewhat poorly drained.*—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained

soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

*Poorly drained.*—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

*Very poorly drained.*—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

**Drainage, surface.** Runoff, or surface flow of water, from an area.

**Eluviation.** The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

**Erosion.** The wearing away of the land surface by running water, wind, ice, or other geologic agents and by such processes as gravitational creep.

*Erosion* (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

*Erosion* (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes a bare surface.

**Excess fines.** Excess silt and clay. The soil does not provide a source of gravel or sand for construction purposes.

**Favorable.** Favorable soil features for the specified use.

**Fertility, soil.** The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

**Field moisture capacity.** The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

**Fibric soil material (peat).** The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

**Fine textured (heavy textured) soil.** Sandy clay, silty clay, and clay.

**First bottom.** The normal flood plain of a stream, subject to frequent or occasional flooding.

**Flagstone.** A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 37.5 centimeters) long.

**Flooding.** The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; *November-May*, for example, means that flooding can occur during the period November through May. Water standing for short periods after rainfall or commonly covering swamps and marshes is not considered flooding.

**Flood plain.** A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

**Foot slope.** The inclined surface at the base of a hill.

**Forage.** Plant material used as feed by domestic animals. Forage can be grazed or cut for hay.

**Frost action.** Freezing and thawing of soil moisture. Frost action can damage structures and plant roots.

**Genesis, soil.** The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

**Glacial drift** (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the assorted and unassorted material deposited by streams flowing from glaciers.

**Glacial outwash** (geology). Gravel, sand, and silt, commonly stratified, deposited by melt water as it flows from glacial ice.

**Glacial till** (geology). Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

**Glaciofluvial deposits** (geology). Material moved by glaciers and subsequently sorted and deposited by

streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

**Glaciolacustrine deposits.** Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes by water originating mainly from the melting of glacial ice. Many are interbedded or laminated.

**Gleyed soil.** A soil having one or more neutral gray horizons as a result of waterlogging and lack of oxygen. The term "gleyed" also designates gray horizons and horizons having yellow and gray mottles as a result of intermittent waterlogging.

**Grassed waterway.** A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

**Gravel.** Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

**Gravelly soil material.** Material from 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

**Green manure** (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

**Ground water** (geology). Water filling all the unblocked pores of underlying material below the water table, which is the upper limit of saturation.

**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.

**Habitat.** The natural abode of a plant or animal; refers to the kind of environment in which a plant or animal normally lives, as opposed to the range or geographical distribution.

**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. The major horizons of mineral soil are as follows:

*O horizon.*—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

*A horizon.*—The mineral horizon, formed or forming at or near the surface, in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon most of which was originally part of a B horizon.

*A2 horizon.*—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

*B horizon.*—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

*C horizon.*—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

*R layer.*—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

**Hummocky.** Refers to a landscape of hillocks, separated by low sags, having sharply rounded tops and steep sides. Hummocky relief resembles rolling or undulating relief, but the tops of ridges are narrower and the sides are shorter and less even.

**Humus.** The well decomposed, more or less stable part of the organic matter in mineral soils.

**Hydrologic soil groups.** Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered, but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

**Impervious soil.** A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

**Infiltration.** The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

**Infiltration capacity.** The maximum rate at which water can infiltrate into a soil under a given set of conditions.

**Infiltration rate.** The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

**Irrigation.** Application of water to soils to assist in production of crops. Methods of irrigation are—

*Border.*—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

*Basin.*—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

*Controlled flooding.*—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

*Corrugation.*—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

*Furrow.*—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

*Sprinkler.*—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

*Subirrigation.*—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

*Wild flooding.*—Water, released at high points, is allowed to flow onto an area without controlled distribution.

**Kame** (geology). An irregular, short ridge or hill of stratified glacial drift.

**Lacustrine deposit** (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

**Landslide.** The rapid downhill movement of a mass of soil and loose rock generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

**Leaching.** The removal of soluble material from soil or other material by percolating water.

**Light textured soil.** Sand and loamy sand.

**Liquid limit.** The moisture content at which the soil passes from a plastic to a liquid state.

**Loam.** Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

**Loess.** Fine grained material, dominantly of silt-sized particles, deposited by wind.

**Low strength.** Inadequate strength for supporting loads.

**Medium textured soil.** Very fine sandy loam, loam, silt loam, or silt.

**Metamorphic rock.** Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

**Mineral soil.** Soil that is mainly mineral material and low in organic material. Its bulk density is greater than that of organic soil.

**Minimum tillage.** Only the tillage essential to crop production and prevention of soil damage.

**Miscellaneous areas.** Areas that have little or no natural soil, are too nearly inaccessible for orderly examination, or cannot otherwise be feasibly classified.

**Moderately coarse textured (moderately light textured) soil.** Sandy loam and fine sandy loam.

**Moderately fine textured (moderately heavy textured) soil.** Clay loam, sandy clay loam, and silty clay loam.

**Moraine** (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Types are terminal, lateral, medial, and ground.

**Morphology, soil.** The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

**Mottling, soil.** Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse* more than 15 millimeters (about 0.6 inch).

**Muck.** Dark colored, finely divided, well decomposed organic soil material mixed with mineral soil material. The content of organic matter is more than 20 percent.

**Munsell notation.** A designation of color by degrees of the three single variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

**Neutral soil.** A soil having a pH value between 6.6 and 7.3.

**Nutrient, plant.** Any element taken in by a plant, essential to its growth, and used by it in the production of food and tissue. Plant nutrients are nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and perhaps other elements obtained from the soil; and carbon, hydrogen, and oxygen obtained largely from the air and water.

**Outwash, glacial.** Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by water that originated mainly from the melting of glacial ice. Glacial outwash is commonly in valleys on landforms known as valley trains, outwash terraces, eskers, kame terraces, kames, outwash fans, or deltas.

**Outwash plain.** A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

**Pan.** A compact, dense layer in a soil. A pan impedes the movement of water and the growth of roots. The word "pan" is commonly combined with other words that more explicitly indicate the nature of the layer; for example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

**Parent material.** The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

**Peat.** Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture.

**Ped.** An individual natural soil aggregate, such as a granule, a prism, or a block.

**Pedon.** The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

**Percolation.** The downward movement of water through the soil.

**Percs slowly.** The slow movement of water through the soil adversely affecting the specified use.

**Permeability.** The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the soil. Terms describing permeability are *very slow* (less than 0.06 inch), *slow* (0.06 to 0.20 inch), *moderately slow* (0.2 to 0.6 inch), *moderate* (0.6 to 2.0 inches), *moderately rapid* (2.0 to 6.0 inches), *rapid* (6.0 to 20 inches), and *very rapid* (more than 20 inches).

**Phase, soil.** A subdivision of a soil series or other unit in the soil classification system based on differences in the soil that affect its management. A soil series, for example, may be divided into phases on the basis of differences in slope, stoniness, thickness, or some other characteristic that affects management. These differences are too small to justify separate series.

**pH value.** (See Reaction, soil). A numerical designation of acidity and alkalinity in soil.

**Piping.** Moving water forms subsurface tunnels or pipe-like cavities in the soil.

**Plasticity index.** The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

**Plastic limit.** The moisture content at which a soil changes from a semisolid to a plastic state.

**Plowpan.** A compacted layer formed in the soil directly below the plowed layer.

**Ponding.** Temporary accumulation of water in closed depressions or in flat areas on the upper part of drainage basins.

**Poorly graded.** Refers to soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

**Productivity** (soil). The capability of a soil for producing a specified plant or sequence of plants under a specified system of management. Productivity is measured in terms of output, or harvest, in relation to input.

**Profile, soil.** A vertical section of the soil extending through all its horizons and into the parent material.

**Reaction, soil.** The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

| | *pH* |
|---|---|
| Extremely acid | Below 4.5 |
| Very strongly acid | 4.5 to 5.0 |
| Strongly acid | 5.1 to 5.5 |
| Medium acid | 5.6 to 6.0 |
| Slightly acid | 6.1 to 6.5 |
| Neutral | 6.6 to 7.3 |
| Mildly alkaline | 7.4 to 7.8 |
| Moderately alkaline | 7.9 to 8.4 |
| Strongly alkaline | 8.5 to 9.0 |
| Very strongly alkaline | 9.1 and higher |

**Regolith.** The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock. Soil scientists regard as soil only the part of the regolith that is modified by organisms and other soil-building forces. Most engineers describe the whole regolith, even to a great depth, as "soil."

**Relief.** The elevations or inequalities of a land surface, considered collectively.

**Residuum (residual soil material).** Unconsolidated, weathered, or partly weathered mineral material that accumulates over disintegrating rock.

**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.** Shallow root zone. The soil is shallow over a layer that greatly restricts roots. See Root zone.

**Root zone.** The part of the soil that can be penetrated by plant roots.

**Runoff.** The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

**Sand.** As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

**Sandstone.** Sedimentary rock containing dominantly sand-size particles.

**Sapric soil material (muck).** The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

**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.** The rapid movement of water through the soil. Seepage adversely affects the specified use.

**Series, soil.** A group of soils, formed from a particular type of parent material, having horizons that, except for the texture of the A or surface horizon, are similar in all profile characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition.

**Shale.** Sedimentary rock formed by the hardening of a clay deposit.

**Sheet erosion.** The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

**Shrink-swell.** The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

**Silica-sesquioxide ratio.** The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

**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.

**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.

**Slickensides.** Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

**Slope.** The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

**Slow refill.** The slow filling of ponds, resulting from restricted permeability in the soil.

**Small stones.** Rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Small stones adversely affect the specified use.

**Soil.** A natural, three-dimensional body at the earth's surface that is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

**Soil separates.** Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *very coarse sand* (2.0 millimeters to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter).

**Solum.** The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

**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.

**Stratified.** Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

**Stripcropping.** Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

**Structure, soil.** The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

**Subsoil.** Technically, the B horizon; roughly, the part of the solum below plow depth.

**Substratum.** The part of the soil below the solum.

**Subsurface layer.** Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

**Surface soil.** The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

**Taxadjuncts.** Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use or management.

**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 it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

**Terrace** (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. A stream terrace is frequently called a second bottom, in contrast with a flood plain, and is seldom subject to overflow. A marine terrace, generally wide, was deposited by the sea.

**Texture, soil.** The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

**Thin layer.** Otherwise suitable soil material too thin for the specified use.

**Till plain.** An extensive flat to undulating area underlain by glacial till.

**Tilth, soil.** The condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

**Toe slope.** The outermost inclined surface at the base of a hill; part of a foot slope.

**Topsoil** (engineering). Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

**Upland** (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

**Unstable fill.** Risk of caving or sloughing in banks of fill material.

**Variant, soil.** A soil having properties sufficiently different from those of other known soils to justify a new series name, but the limited geographic soil area does not justify creation of a new series.

**Variegation.** Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

**Varve.** A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within 1 year; specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by melt water streams, in a glacial lake or other body of still water in front of a glacier.

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

**Weathering.** All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

**Well graded.** Refers to a soil or soil material consisting of particles well distributed over a wide range in size

or diameter. Such a 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.

# ILLUSTRATIONS

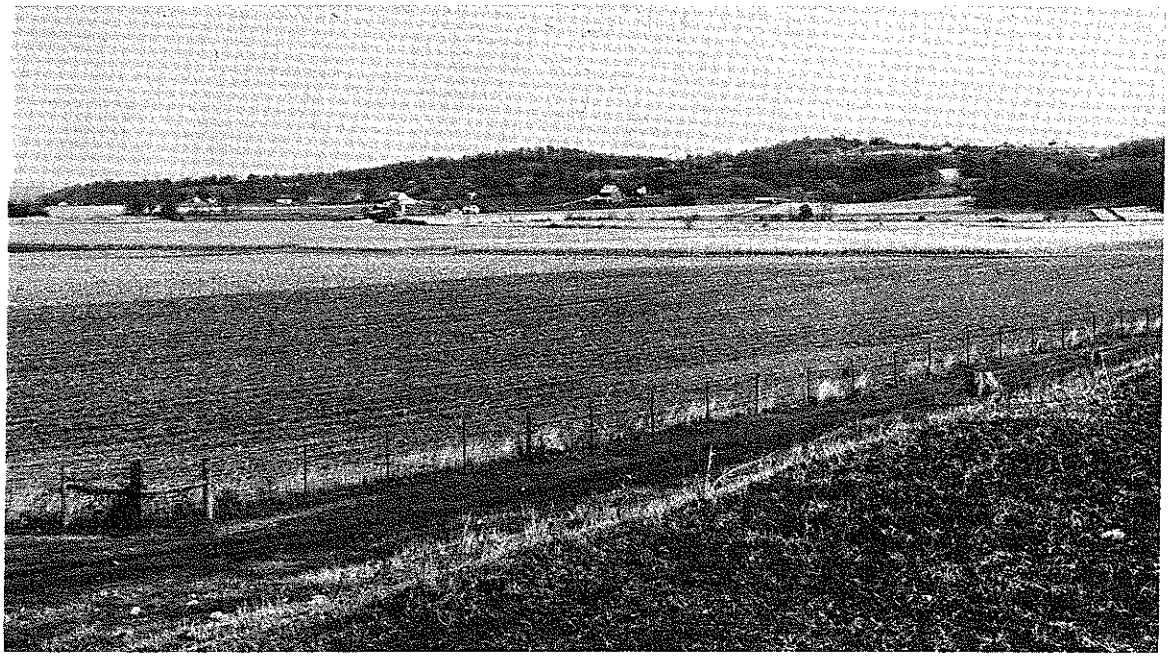

*Figure 1.*—Cash grain and livestock farming, the major land use in Logan County. Algiers, Homer, and Lippincott soils are in the cropped areas; Eldean soils, on the building site.

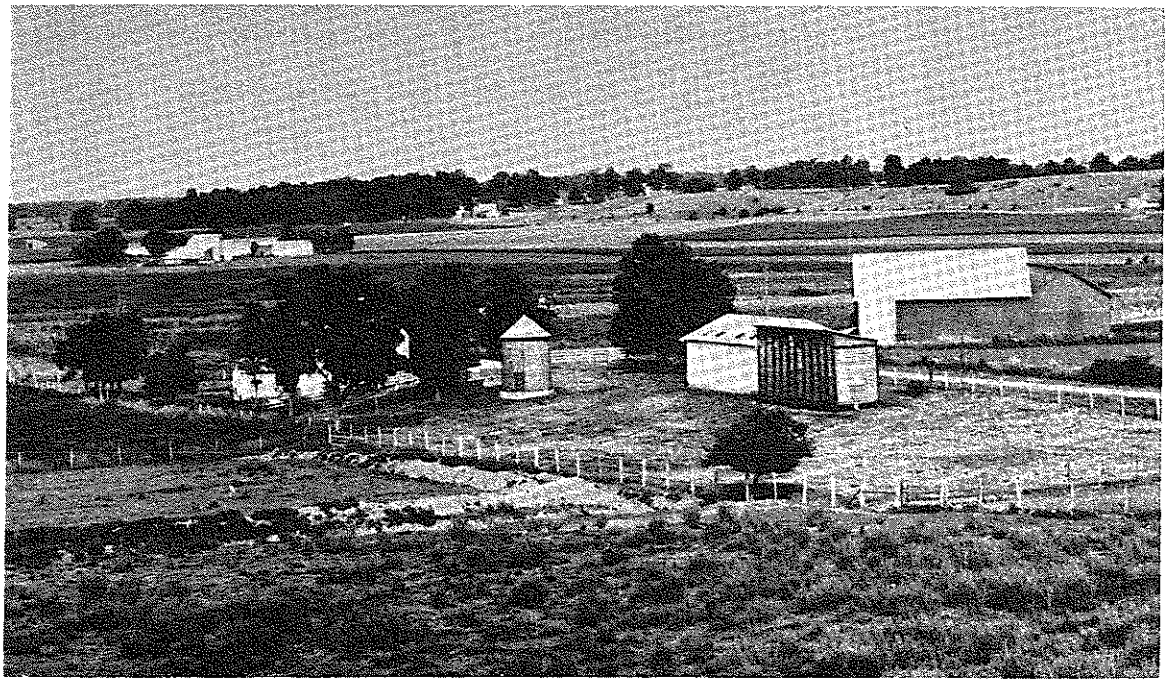

*Figure 2.*—An area of the Eldean-Algiers map unit. This unit is used mainly for cash grain and general farming.

*Figure 3.*—Urban development on Eldean silt loam, 0 to 2 percent slopes.

*Figure 4.*—Harvesting winter wheat on Eldean silt loam, 2 to 6 percent slopes. This soil is well suited to winter wheat.

*Figure 5.*—Buildings on Eldean silt loam, 2 to 6 percent slopes. This soil is well suited to building site development.

*Figure 6.*—Cracks in the surface layer of Nappanee silt loam, 2 to 6 percent slopes, during an extremely dry period.

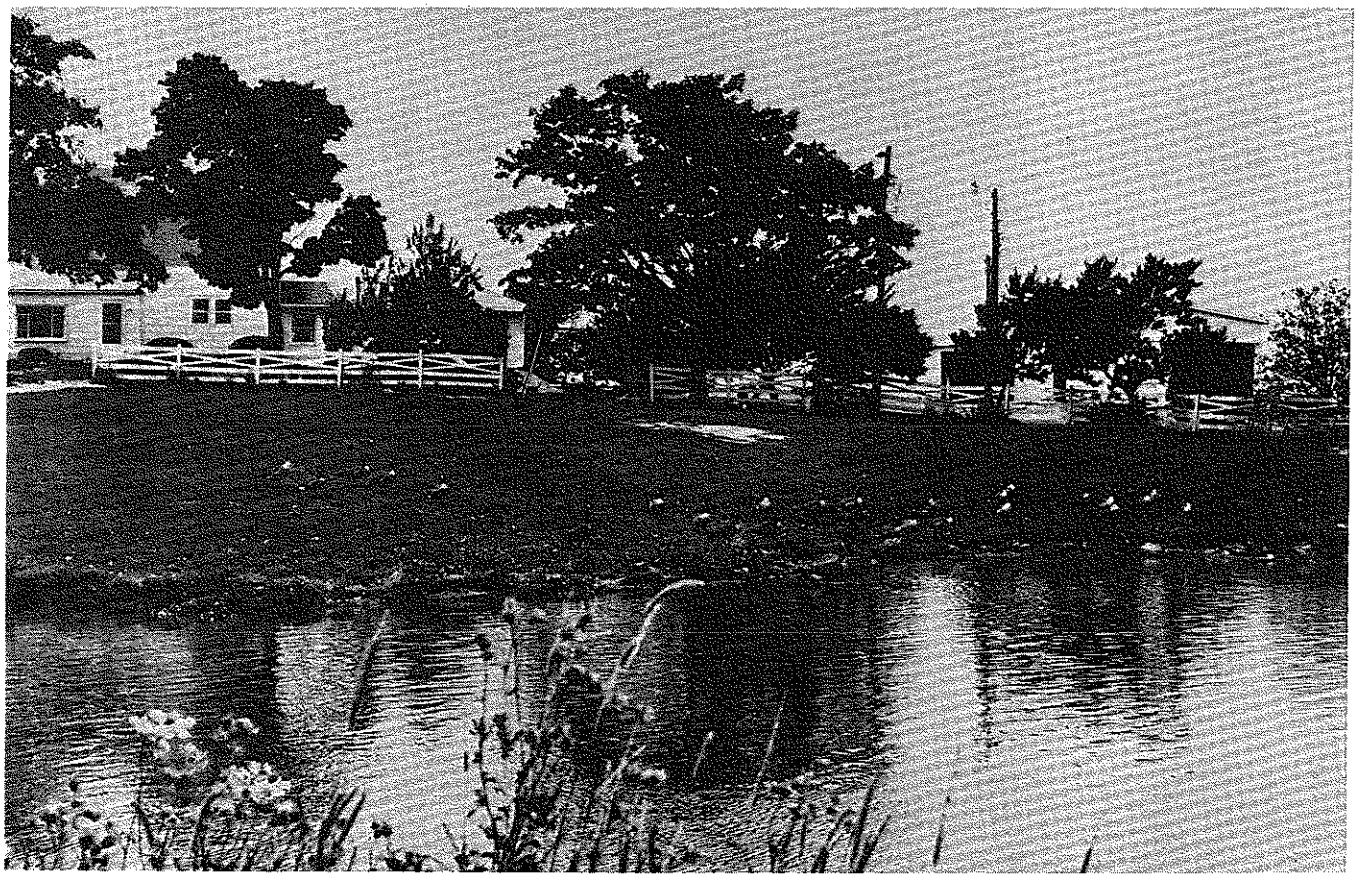

*Figure 7.*—Farm pond on Nappanee silt loam, 2 to 6 percent slopes. The pond provides livestock water and fire protection.

*Figure 8.*—Corn on Ockley silt loam, 0 to 2 percent slopes. This soil is well suited to corn.