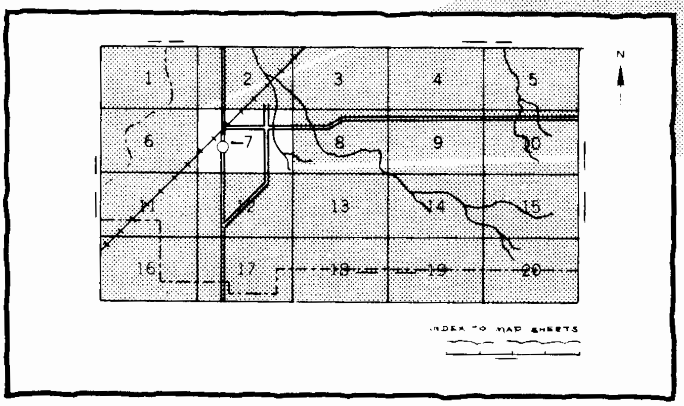
SOIL SURVEY OF

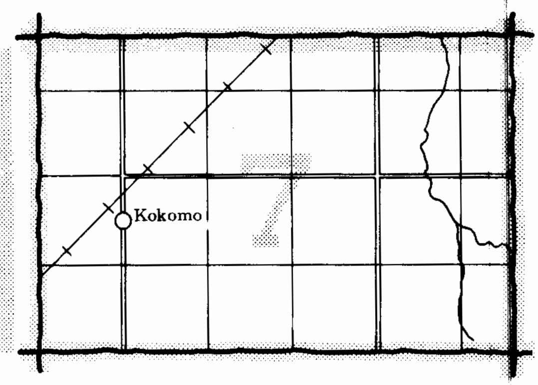
Crawford County, Ohio

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 USE

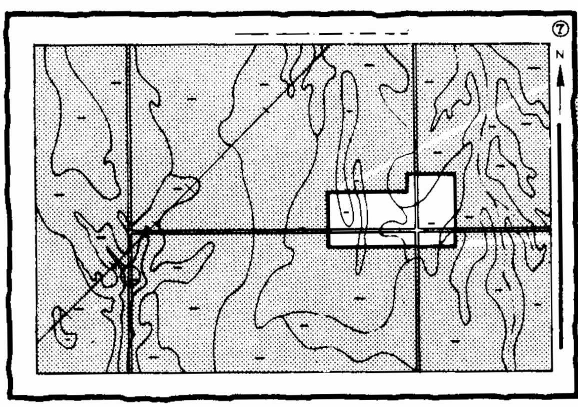
1. Locate your area of interest on the ''Index to Map Sheets'' (the last page of this publication).

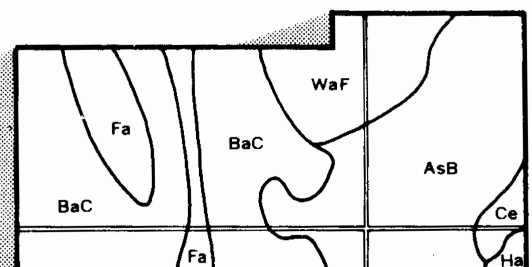




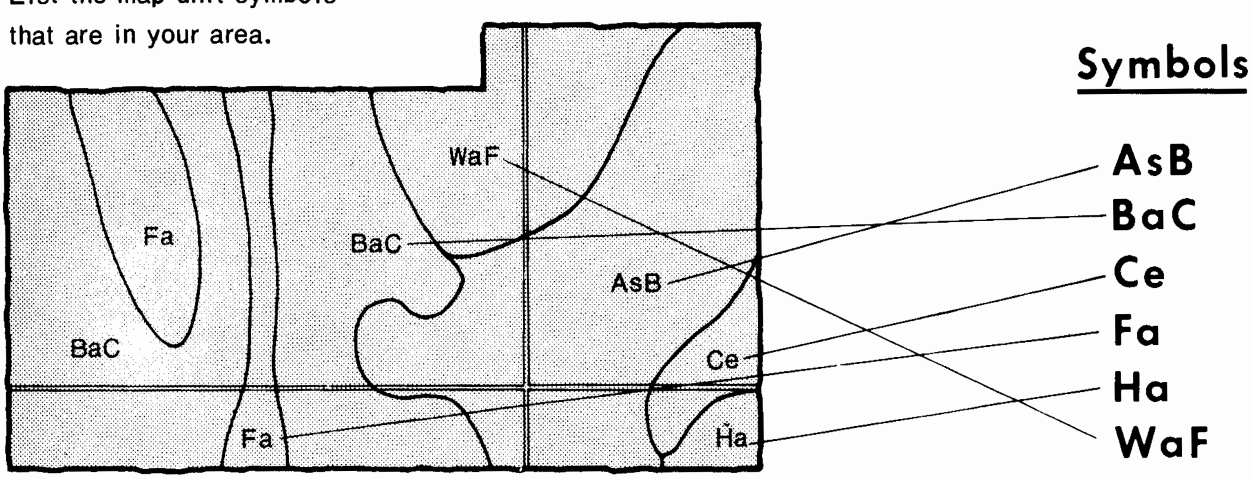
2. Note the number of the map sheet and turn to that sheet.

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



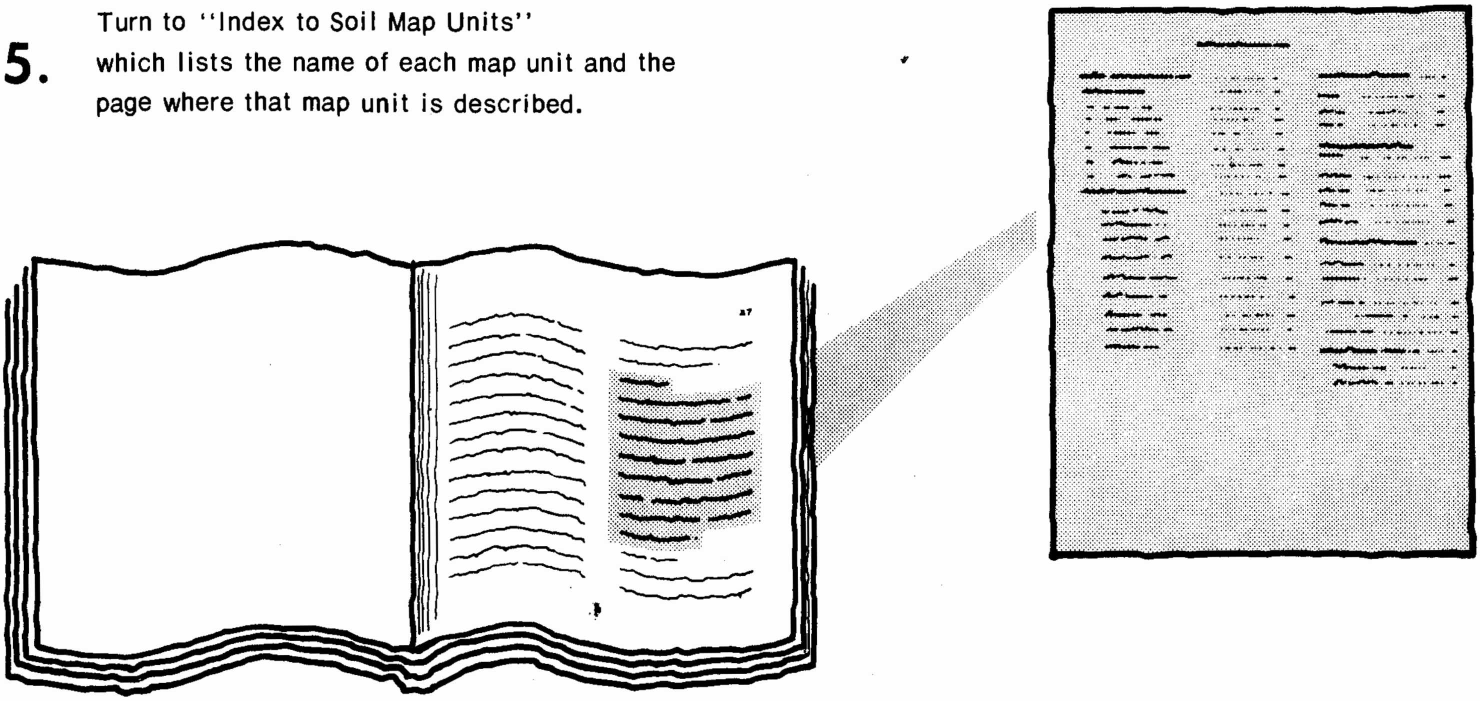


4. List the map unit symbols that are in your area.

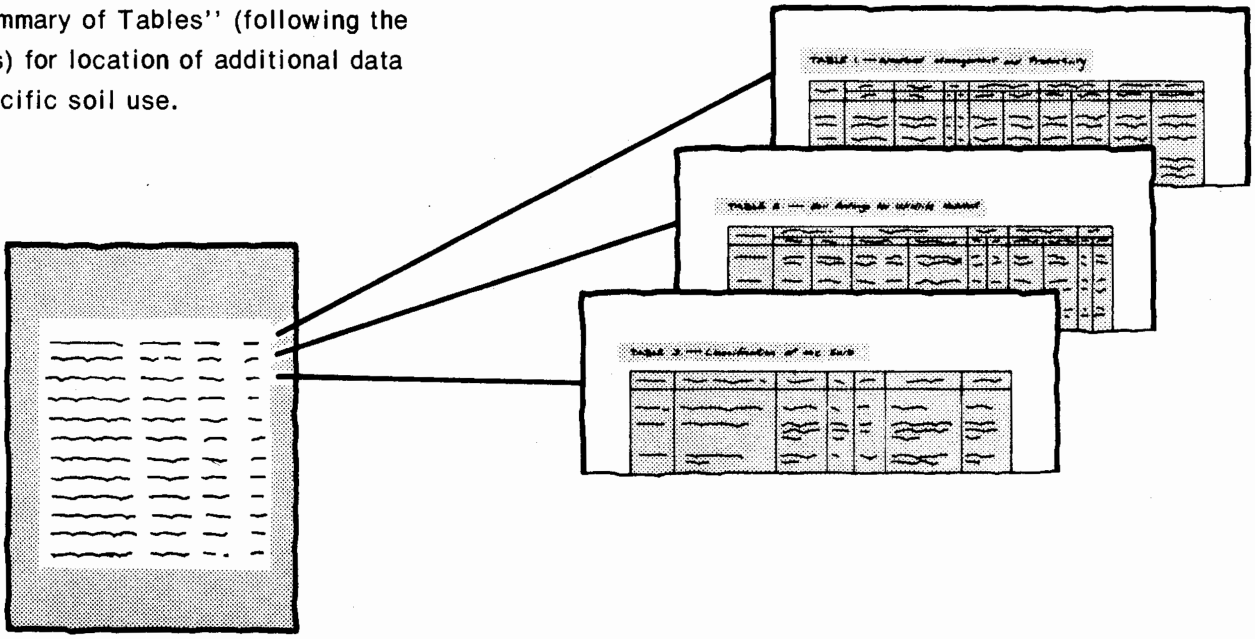


THIS SOIL SURVEY

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



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



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

This 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 1969-74. Soil names and descriptions were approved in 1975. Unless otherwise indicated, statements in the publication refer to conditions in the survey area in 1974. This survey was made cooperatively by the Soil Conservation Service, the Ohio Department of Natural Resources, Divisions of Lands and Soil, and the Ohio Agricultural Research and Development Center. It is part of the technical assistance furnished to the Crawford Soil and Water Conservation District.

This survey was aided by funds provided by the Crawford County Commissioners.

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.

Contents

Issued April 1979

Index to Map Units

Summary of Tables

Foreword

We introduce the Soil Survey of Crawford 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.

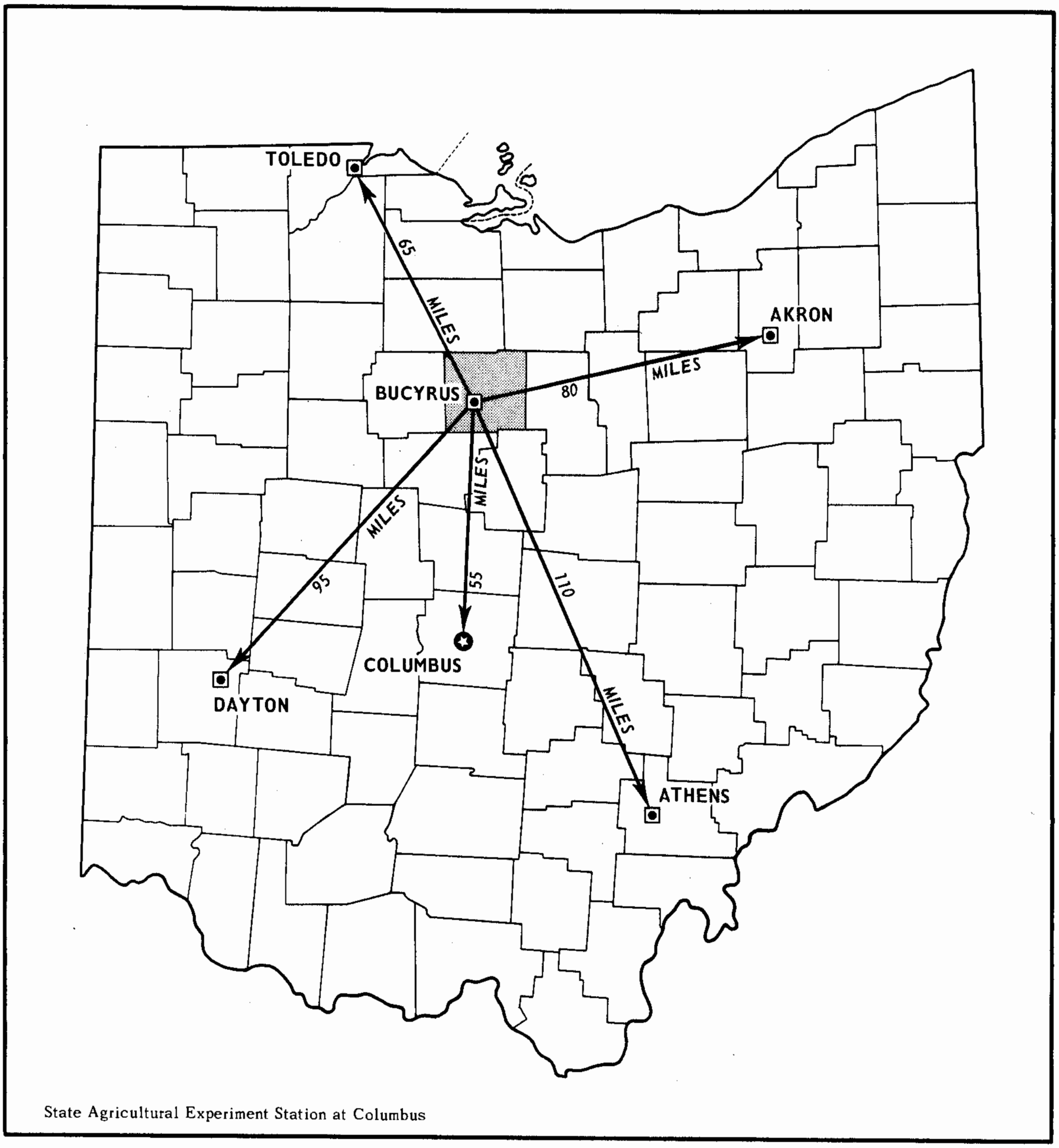
This soil survey has been prepared to meet the needs of different users. Farmers, ranchers, foresters, and agronomists can use it to determine the potential of the soil and the management practices required for food and fiber production. Planners, community officials, engineers, developers, builders,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

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 soils and, on the 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 related resources.

Robert E. Quilliam
State Conservationist
Soil Conservation Service



Location of Crawford County in Ohio.

SOIL SURVEY OF CRAWFORD COUNTY, OHIO

By Joseph R. Steiger, William H. Brug, Robert J. Parkinson, Dan D. LeMaster and Michael K. Plunkett, Soil Conservation Service

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

CRAWFORD COUNTY is in the north-central part of Ohio (see locator map) on the watershed divide between Lake Erie and the Ohio River. It is in the eastern part of the corn belt. It is in the Indiana and Ohio Till Plain of the Central Lowland Province of North America. It has a total land area of 258,560 acres or 404 square miles.

The county was originally covered by hardwood forest and had a few areas of marshland and open prairie (*5*, *6*). The first major white settlement was established about 1820. Population of the county in 1970 was 50,364. Bucyrus is the county seat. Bucyrus, Crestline, and Galion are the largest centers of population.

Most of the land in the county is used for cultivated crops, but about 10 percent remains in woodland. The use of artificial drainage to improve the soils for farming has been extensive.

General nature of the county

This section gives general information concerning the county. It discusses climate, history of land development, population, industry, and transportation, physiography, relief, and drainage, geologic history, ground water resources, and farming.

Climate

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

Table 1 gives data on temperature and precipitation for the survey area, as recorded at Bucyrus, 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 28 degrees F, and the average daily minimum temperature is 19 degrees. The lowest temperature on record, which occurred at Bucyrus on January 24, 1963, is -19 degrees. In summer the average temperature is 70 degrees, and the average daily maximum temperature is 82 degrees. The highest recorded temperature, which occurred on September 3, 1953, is 100 degrees.

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

Of the total annual precipitation, 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 17 inches. The heaviest 1-day rainfall during the period of record was 5.42 inches at Bucyrus on June 20, 1973. Thunderstorms number about 40 each year, 20 of which occur in summer.

Average seasonal snowfall is 34 inches. The greatest snow depth at any one time during the period of record was 16 inches. On the average, 24 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.

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

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

History of land development

First accounts of the land that is now Crawford County came from Indian traders of the eighteenth century. The land was occupied by the Wyandots, Delawares, and other tribes of Indians. The county acquired its name from William Crawford, a colonel in the American Revolutionary War.

The western part of Crawford County remained a part of the Wyandot Indian treaty lands until about 1830. The first major number of white settlers arrived in the county about 1820. Most early immigrants came from Pennsylvania. Later, in the 1840's, a relatively large group of German and Irish immigrants came to the area as the railroads were constructed. Settlers were faced with the task of clearing the hardwood forests; draining extensive land areas; and constructing houses, barns, and roads to develop the area for farming.

The first land to be cultivated was the better drained rolling land along streams and higher ground on moraines. Cattle, hogs, and sheep were pastured on the woodland and swampy land. Crops grown in the early period of development were used locally for livestock and human consumption. Markets were inaccessible because of poor roads. When railroads were completed, grain, livestock, and dairy products were shipped to distant markets. Improved markets resulted in more land being cultivated. The wetter soils that needed drainage required ditches and tile drains. This added investment reduced expansion, since most work was by manual labor and animal power. The development of power machinery for farming in the early twentieth century increased the ability of farmers to clear, drain, and cultivate the land. More recent improvements in tractors and other farm machinery have been rapid and have drastically reduced the need for manpower.

Mechanized farming is more labor efficient and has made possible the cultivation of large acreages by relatively few farmers in the county. Currently, fields are being enlarged by removing fencerows. Generally, fences are less needed because livestock on many farms is now confined in feedlots and barns. Continued clearing of land is removing some of the existing woodlands, particularly where drainage is being improved. The use of plastic drain tubing and automated trenching machines have reduced the labor requirements and cost of installing underground drains. The trend toward more intensive cropping and higher production levels using improved techniques is likely to continue.

Population, industry, and transportation

The population of Crawford County has increased from 4,791 in 1830 and 35,345 in 1950 to 50,364 in 1970. The highest growth rates occurred in 1830 to 1840 and 1950 to 1960.

Industries include manufacturing, retailing, transportation services, farming, and construction. These are in order of the number of people they employ (*4*).

Farming accounts for 90 percent of the land use in the county, but only 783 people are directly employed in farming. The trend toward larger commercial farms continues as tenant, part-time, and general livestock farming decreases. Forty percent of the farmers reported working off the farm more than 100 days in 1970 (*4*).

Manufacturing consists of large and small firms that make machinery and transportation equipment, primary metals, electrical equipment, and plastic products and firms that process food.

A limestone mine in Holmes Township produces crushed stone and agricultural lime. A few producing oil and gas wells are scattered throughout the county.

Bucyrus, Crestline, and Galion are the most important centers of retail trade. They also provide personal services, entertainment, auto repair shops, and motels. The economy is balanced and is growing at a stable rate. In cities and villages about 1/2 to 2/3 of the land is in residential uses; 1/5 to 1/4 is in commercial or industrial uses; and 1/5 to 1/4 is in public and semipublic uses and in parkland.

Transportation by road, rail, and air is available. Major state highways that serve the county are Route 30 (east-west) and Route 4 (north-south). Other connecting roads are maintained by the state and the county. Local township roads form a network that gives access to nearly every side of each square mile.

Mainline rail service available in the county is east-west between Pittsburg and Chicago and north-south between Cleveland and Columbus. Passenger service is available at Crestline. Municipal airports are near Bucyrus and Galion.

Community facilities include several elementary and high schools. Each city has a library, a hospital, and local parks. No large recreational areas are in the county.

Physiography, relief, and drainage

Surface features in Crawford County vary from gently rolling hills to nearly level plains and flat basins. The county is on the divide between north- and south-flowing rivers. No major rivers cross the area. The headwaters of the Huron, Muskingum, Sandusky, and Scioto Rivers, however, are in the county.

Glacial drift, which covers the entire county, consists of ground moraines that are undulating; end moraines that are rolling, irregular belts that cross the county in an east-west direction; lake plains that lie in local basins between moraines; and a few melt water deposits of sand and gravel.

Total relief is 380 feet. The lowest point at Buckeye Creek near the northwest corner of the county is 854 feet above sea level, and the highest point is 1,234 feet near the southeast corner.

Geologic history

The oldest rocks exposed in Crawford County are Devonian (*8*). This period began about 400 million years ago. By Middle Devonian, saltwater seas covered most of Ohio. They were warm, if not subtropical, as indicated by abundance of coral in the rock from this period. Thick deposits of carbonate material accumulated in these seas. The beds are represented by Columbus and Delaware Limestones that outcrop in the western part of Crawford County.

In Late Devonian, the seas deepened and became stagnant. Lime in the sediments decreased; the carbon content increased. Muddy gray and black sediments were later consolidated into the Olentangy Shale and Ohio Shale.

At the beginning of the Mississippian Period, gray shale continued to accumulate in Crawford County. Gradually, as land areas to the east were uplifted, the gray mud gave way to silty and fine sands and some coarser sand and gravel. The gray mud formed Bedford Shale and the sandy sediment, Berea Sandstone.

Following the deposition of sand, the seas again encroached widely upon the land. The black mud which makes up the Sunbury Shale was then deposited. Another series of uplifts of the land to the east contributed sand and silt to the seas and formed the alternating beds of the Cuyahoga Formation.

The Teays stage is represented in Crawford County by the ancient Tiffin River. The Tiffin River did not flow into the Teays River but was on the opposite side of a divide and flowed northward into the system of streams that drain the present Great Lakes area. This stream drained a rather large area in Sandusky, Seneca, Crawford, Wyandot, and Marion Counties. The Tiffin River and much of the Teays River was overridden and modified by the glaciers. Glacial drift now covers much of the old valley which was entrenched rather deeply but was wide and had a flat bottom. Headwater of the Tiffin River is south of Bucyrus and west of Marion. Generally, the tributaries are small. The largest is an eastern branch that originated near Chatfield.

About a million years ago during the Pleistocene Epoch of the Cenozoic Era the climate of North America slowly cooled by about 10 degrees F and huge continental glaciers began to form and move southward (*7*, *11*). At least two major advances of the ice, Illinois and Wisconsin, crossed Crawford County. The ice sheets scoured the bedrock and picked up rock fragments and soil, which they transported great distances. When the melting front of the glacier remained stationary, a ridge of glacial drift or an end moraine formed at the edge of the ice. Such ridges are the Fort Wayne, Wabash, and Broadway End Moraines in the central and southeastern parts of the county. As the glacier slowly advanced, a more even layer of drift mantled the bedrock and covered the land between the end moraines. The Wisconsin Ground Moraine is an example of this.

The most prominent structural feature affecting the bedrock of Crawford County is the Cincinnati arch. It is a regional feature of considerable magnitude, extending from northern Alabama through Cincinnati, Ohio, into southern Canada. The arch is a broad, low structure and is very conspicuous in the western half of Ohio. The rocks dip gently northward along the crest of the arch, dip rather rapidly off the arch to the west, and dip much more rapidly off the arch to the east into the great Appalachian geosyncline.

Crawford County lies on the east flank of the Cincinnati arch. Therefore, the rocks strike north-south and dip eastward, or slightly southeast. The regional decline is about 31 feet per mile. Because of this easterly dip, Devonian rocks outcrop in the western part of the county and the younger Mississippian formations are exposed along the eastern part.

Ground water resources

Two major types of water-bearing materials are in Crawford County (*8*, *13*, *16*): (1) The glacial deposits are on the surface or at a shallow depth. They are loose, unconsolidated formations of clay, silt, sand, and gravel that occur as a heterogeneous mixture of glacial till or as well sorted, stratified layers. (2) The bedrock formation beneath the glacial material makes up consolidated sedimentary layers of limestone, shale, and sandstone.

A blanket of glacial material covers the entire county and ranges from 10 to more than 100 feet in thickness. Glacial moraines in the north-central part of the basin average more than 50 feet in thickness and contain frequent lenses or veins of sand and gravel. Wells in Holmes, Liberty, and Sandusky Townships are drilled into the sand and gravel to depths of 30 to 90 feet and typically yield 10 to 20 gallons of potable water per minute. This is suitable for most domestic needs.

Rather extensive sand and gravel layers, interbedded with clay, are present in an area immediately east of Bucyrus and south of the Sandusky River. Wells in the area, drilled to depths of 30 to 60 feet, commonly supply 25 to 50 gallons per minute, although yields of more than 100 gallons per minute have been reported.

The bedrock in the western part of the county consists of limestone. The amount of water in this rock depends upon the size and number of water-storing cracks and crevices. Furthermore, since the fracture pattern of the rock can rarely be detected from surface conditions and varies considerably from one location to the next, a rather wide range in potential yield can be expected from wells that developed in limestone or dolomite. Yields as much as 300 gallons per minute can be expected from bedrock wells in this part of the basin at depths of 150 to 250 feet. Farm or domestic supplies are readily available at depths of 50 to 125 feet.

Devonian and Mississippian shales are the uppermost bedrock strata in the central part of the county. In areas where the glacial material is thin or predominantly clay, wells must be drilled into the underlying bedrock. Shale is unfavorable for developing reliable ground water supplies because of its low permeability. A cistern or dug well is often needed to supplement wells drilled into shale. Yields of 2 to 5 gallons per minute are sometimes available from the upper weathered part of the rock. Deep wells into the limestone beneath the shale are likely to produce highly mineralized saltwater.

The Berea Sandstone is the primary water-bearing formation in the eastern part of the county. Sandstone wells average about 15 gallons per minute at a depth of 50 to 150 feet. Glacial material, ranging from 10 to 90 feet in thickness, covers the Berea Sandstone. Locally, where the glacial deposits are thick, limited supplies of water are available from sand and gravel. A few sandstone wells in the basin have reported yields of more than 50 gallons per minute.

Farming

In 1969, Crawford County had more than 1,500 farms. Farms made up more than 90 percent of the land in the county. About 80 percent of the farms, or 194,601 acres, was in cropland. Of this about 52,000 acres, each, was in corn and soybeans; more than 20,000 acres was in wheat; about 11,000 acres was in other small grain, mostly oats; more than 12,000 acres was in hay; about 28,000 acres was idle, fallow, or in soil conservation programs; about 2,000 acres was in other crops; and about 17,000 acres was used for pasture. Permanent pasture made up nearly 17,000 acres, woodland 23,000 acres, and other uses 20,000 acres. Current trend is toward increased acreage for row crops and a decline in hay and pasture or woodland.

Hogs, beef cattle, sheep, dairy, and poultry are important in Crawford County. In 1969, more than 60 percent of the farm income was from the sale of livestock. Sale of grain accounted for nearly all of the remaining 40 percent of farm income.

Farms average about 160 acres in size. Most range from 50 to 500 acres, many are less than 50 acres, and some are more than 500 acres. Most are individual or partnership operations of farm families. Tenants operate about 12 percent of the farms. The farms are highly mechanized with machines doing nearly all the tillage, planting, cultivating, harvesting, drying, storing, and shipping of crops. The trends are toward larger equipment and more on-farm storage with shipment directly to terminals for export or processing.

How this survey was made

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

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

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

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

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

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it is readily available to different groups of users, among them farmers, managers of rangeland and 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 lacustrine sediment on lake plains and glacial till on uplands

This group is made up of map units that are throughout the county. The soils formed mainly in water-deposited silts and clays, and some formed partly or entirely in glacial till. They are mainly nearly level and gently sloping.

1. Tiro-Condit-Luray

Nearly level and gently sloping, somewhat poorly drained, poorly drained, and very poorly drained soils; formed in lacustrine sediment and glacial till

This map unit is in the northern and eastern parts of Crawford County. It is on the flats around North Robinson, north of Crestline, and in parts of Chatfield and Lykens Townships. About 14 percent of the total land area in the county is in this map unit.

Tiro soils formed in glacial lake deposited silty sediment overlying glacial till. They are nearly level and gently sloping and are somewhat poorly drained. Condit soils formed in glacial till. They are nearly level and poorly drained. The Luray soils, which are conspicuous by their dark surface color, formed in glacial lake silty sediment. They are nearly level and very poorly drained.

Tiro soils occupy about 45 percent of this map unit; Condit soils, about 15 percent; Luray soils, about 15 percent; and minor soils, about 25 percent. Among the minor soils are the Bennington, Fitchville, Sebring, Pewamo, Lenawee, and Olmsted soils. The Bennington and Fitchville soils are somewhat poorly drained; the Sebring soils are poorly drained; the Lenawee soils are poorly drained and very poorly drained; and the Pewamo and Olmsted soils are very poorly drained.

Seasonal wetness, which includes ponding of surface water on Condit and Luray soils, is the major limitation of this map unit for farming and many nonfarm uses. Moderately slow and slow permeability are additional limitations for some nonfarm uses. When artificially drained and properly managed, the soils in this map unit are moderately to highly productive. Most areas of this map unit have been cleared and are used for cropland. Corn, soybeans, and wheat are the most commonly grown crops. Because of wetness and high value for cropland, this map unit is less desirable for nonfarm development than most other map units in the county.

2. Luray-Tiro

Nearly level and gently sloping, very poorly drained and somewhat poorly drained soils; formed in lacustrine sediment and glacial till

This map unit is between the Sandusky and Olentangy Rivers, and small areas are between the Sandusky River and Brokensword Creek. This map unit is a part of the Sandusky Plains, a region known for its level expanses of dark colored soils. About 10 percent of the total land area in the county is in this map unit.

Luray soils formed in silty and clayey, glacial lake deposited sediment. They are nearly level and very poorly drained. They are darker colored than Tiro soils. Tiro soils formed in glacial lake deposited sediment overlying glacial till. They are somewhat poorly drained, nearly level and gently sloping soils on slight rises or swells on an otherwise nearly level landscape.

Luray soils occupy about 40 percent of this map unit; Tiro soils, about 25 percent; and minor soils, about 35 percent. Among the minor soils are Pewamo, Bono, Olmsted, Elliott, Fitchville, Blount, and Lykens. Pewamo, Bono, and Olmsted soils are very poorly drained; Elliott, Fitchville, and Blount soils are somewhat poorly drained; and Lykens soils are moderately well drained.

Seasonal wetness and ponding of surface water on Luray soils are the major limitations of this map unit for farming and many nonfarm uses. Nearly all areas have been artificially drained and are intensively cultivated. The major crops are corn, soybeans, and wheat. This map unit is well suited to cropland. Because of wetness, it is less desirable for nonfarm development than many other map units in Crawford County.

3. Lenawee-Bono

Nearly level, poorly drained and very poorly drained soils; formed in calcareous, lacustrine sediment

This map unit is in the northeastern part of the county. The Willard and Cranberry marshes of Auburn and Cranberry Townships are in this map unit. The most outstanding feature is the uniform, almost flat surface and the nearly black soils that cover most of the area. About 3 percent of the total land area in the county is in this map unit.

The major soils formed in silty and clayey sediment deposited in the center of former glacial lake basins. Lenawee soils are poorly drained and very poorly drained and nearly level. Bono soils are nearly level and very poorly drained. In some areas of the Lenawee soils, particularly in the Willard Marsh area bordering Huron County, the subsoil requires large amounts of lime for optimum crop production. Bono soils are very similar to Lenawee soils, but have a thicker surface layer and occupy lower positions on the landscape.

Lenawee soils occupy 50 percent of the map unit; Bono soils, 30 percent; and minor soils 20 percent. Among the minor soils are Del Rey, Luray, Carlisle, Colwood, and

Pewamo. Del Rey soils are somewhat poorly drained; and Luray, Carlisle, Colwood, and Pewamo soils are very poorly drained.

Severe wetness and ponding of surface water for extended periods in winter and spring, particularly on Bono soils, are the major limitations of this map unit for farming and most nonfarm uses. The land in this map unit was some of the most recent in the county to be cultivated. Drainage channels had to be constructed since few natural outlets existed. Although the areas are artificially drained, crops are commonly damaged or lost because of extreme wetness in very rainy seasons. Where present drainage systems are not maintained, the soils tend to become wet and swampy. The undrained areas have potential for wetland wildlife habitat. Only a small part of this map unit is used for pasture or woodland.

Soils formed in glacial till on uplands

This group is made up of map units from all parts of the county. The soils are on glaciated uplands and formed mainly in glacial till. They are mainly nearly level to sloping.

4. Bennington-Condit

Nearly level and gently sloping, somewhat poorly drained and poorly drained soils; formed in glacial till

This map is the most extensive in the county. Many areas are in northern and eastern parts of Crawford County. About 23 percent of the total land area in the county is in this map unit.

Bennington and Condit soils formed in glacial till. The Bennington soils are nearly level and gently sloping, and they are somewhat poorly drained. The Condit soils are nearly level and poorly drained.

Bennington soils occupy 50 percent of the map unit; Condit soils, 25 percent; and minor soils, 25 percent. Among the minor soils are the Cardington, Kibbie, Tiro, Luray, and Pewamo. Also included is Urban land in the vicinity of Galion and Crestline. The Cardington soils are moderately well drained, the Kibbie and Tiro soils are somewhat poorly drained, and the Luray and Pewamo soils are very poorly drained.

Seasonal wetness is the main limitation of this map unit for farming and some nonfarm uses. Moderately slow and slow permeability is an additional limitation for a few nonfarm uses. Surface crusting following heavy rainfall is a serious management concern in cultivated areas and tends to reduce infiltration, increase runoff, and retard seedling emergence. Most areas of this map unit have been drained to some extent and are cultivated. Less than 10 percent is in woodland. Undrained areas have potential for production of wetland hardwood trees and development for wildlife habitat.

5. Blount-Pewamo

Nearly level and gently sloping, somewhat poorly drained and very poorly drained soils; formed in glacial till

Broad areas of this map unit are in the western half of the county. About 14 percent of the total land area in the county is in this map unit.

The major soils formed in deposits of glacial till. Blount soils are nearly level and gently sloping, and they are somewhat poorly drained. They are lighter colored than Pewamo soils. They occupy slightly elevated positions commonly surrounding Pewamo soils. The Pewamo soils are nearly level and very poorly drained. They are on the flats and in slight depressions.

Blount soils occupy 35 percent of the map unit; Pewamo soils, 25 percent; and minor soils, 40 percent. Among the minor soils are Glynwood, Alexandria, Bennington, Elliott, and Condit. Also included is some Urban land in Bucyrus. The Glynwood and Alexandria soils are on the higher knolls and ridges. The Glynwood soils are moderately well drained, and the Alexandria soils are well drained. The Bennington and Elliott soils are somewhat poorly drained, and the Condit soils are poorly drained.

Seasonal wetness is the major limitation of this map unit for farming and many nonfarm uses. Ponding of surface water after heavy rainfall is common on Pewamo soils. Moderately slow and slow permeability severely limits Blount and Pewamo soils for some nonfarm uses. This map unit is used mainly for cropland. Surface crusting after heavy rainfall is a serious management concern in cultivated areas of Blount soils. Maintenance of tilth is a common management concern on Pewamo soils if these soils are worked when they are too wet.

6. Wadsworth-Condit

Nearly level and gently sloping, somewhat poorly drained soils with fragipans and nearly level, poorly drained soils; formed in glacial till

A single area south of Galion in the southeastern corner of Crawford County makes up this map unit. About 1 percent of the total land area in the county is in this map unit. It represents the western extension of a large area of these soils in Richland and Morrow Counties.

Wadsworth and Condit soils formed in glacial till. Wadsworth soils have a compact, brittle fragipan at a depth of about 2 feet that impedes percolation of water and root penetration. They are somewhat poorly drained, nearly level and gently sloping soils. Condit soils are poorly drained and nearly level. They have a grayer surface layer and subsoil than Wadsworth soils.

Wadsworth soils occupy 50 percent of the map unit; Condit soils, 20 percent; and minor soils, 30 percent. Among the minor soils are Shoals and Jimtown soils. They are somewhat poorly drained.

Seasonal wetness, including ponding of surface water on Condit soils, is the major limitation of this map unit for farming and many nonfarm uses. Slow and very slow permeability is an additional limitation for some nonfarm uses. Most areas of soils in this map unit have been drained and are under cultivation. Lack of outlets for subsurface drains, strong soil acidity, and surface crusting are management concerns in cultivated areas. Undrained areas are suited to production of wetland hardwood trees and wildlife habitat. Drainage is most commonly the limiting factor for most nonfarm purposes.

7. Cardington-Bennington-Pewamo

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

This map unit is in the northern and eastern parts of the county. This map unit consists of a series of hummocky, irregular belts of glacial moraines. It is considerably higher in elevation than the surrounding map units. About 14 percent of the total land area in the county is in this map unit.

Cardington, Bennington, and Pewamo soils formed in deposits of glacial till. Cardington soils are gently sloping or sloping and are moderately well drained. Bennington soils are nearly level or gently sloping and are somewhat poorly drained. The Pewamo soils are nearly level and very poorly drained. They are at the base of slopes and in depressions. They have a darker and more clayey surface layer than Cardington and Bennington soils.

Cardington, Bennington, and Pewamo soils each occupy 25 percent of the map unit; and minor soils, 25 percent. Among the minor soils are Alexandria, Marengo, Chili, Lykens, Tiro, Condit, and Tuscola.

A moderate to severe hazard of erosion on Cardington soils and seasonal wetness on Bennington and Pewamo soils are the major limitations of this map unit for farming and some nonfarm uses. Some areas of the Pewamo soils are subject to ponding unless adequate drainage is provided. Moderately slow and slow permeability is a limitation for a few nonfarm land uses. Most areas of this map unit are farmed. Corn, soybeans, wheat, and hay are the major crops. About 10 percent of this map unit consists of small, scattered woodlots. Because of better natural drainage, Cardington soils have fewer limitations than Bennington or Pewamo soils for many nonfarm uses.

8. Blount-Glynwood-Pewamo

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

This map unit is on a glacial moraine that extends along the north side of the Sandusky River in the southwestern part of Crawford County. It is considerably higher in elevation than the surrounding map units. About 5 percent of the total land area in the county is in this map unit.

The major soils formed in deposits of glacial till. Blount soils are somewhat poorly drained and nearly level or gently sloping. Glynwood soils are moderately well drained and gently sloping or sloping. They are on ridges and crests of knolls. The Pewamo soils are very poorly drained and nearly level. They are in positions at the base of slopes and in depressions. These soils have a darker and more clayey surface layer than Blount and Glynwood soils.

Blount soils occupy 25 percent of the map unit; Glynwood and Pewamo soils, each 20 percent; and minor soils, 35 percent. Among the minor soils are Chili, Alexandria, Tuscola, Lykens, Tiro, and Elliott. Chili and Alexandria soils are well drained; Tuscola and Lykens soils are moderately well drained; and Tiro and Elliott soils are somewhat poorly drained.

Seasonal wetness on Blount and Pewamo soils and a moderate to severe hazard of erosion on Glynwood soils are the major limitations of this map unit for farming and some nonfarm uses. Ponding of surface water occurs on some Pewamo soils. Moderately slow and slow permeability is a severe limitation for some nonfarm uses. Farming is the major land use in this map unit. Corn, soybeans, wheat, and hay are the major crops. About 10 percent of the map unit consists of small, scattered woodlots. The Glynwood soils have fewer limitations than Blount and Pewamo soils for use as building sites, because of better natural drainage.

Soils formed in glacial till on uplands and in alluvium on flood plains

This group is made up of map units along the major drainage systems in the county. The soils formed in glacial till on the uplands and in alluvium on the flood plains. They are mainly nearly level to moderately steep.

9. Cardington-Shoals

Gently sloping to moderately steep, moderately well drained soils formed in glacial till and nearly level, somewhat poorly drained soils formed in alluvium

This map unit is on the stream valley sides and narrow flood plains in the northern and eastern parts of the county. Most areas of this map unit are a part of the valleys of the Sandusky and Olentangy Rivers and of Sycamore, Honey, and Brokensword Creeks. About 11 percent of the total land area in the county is in this map unit.

Cardington soils formed in glacial till. They are predominantly on hills and bluffs and stream valley sides. Shoals soils formed in alluvium. They are on the narrow flood plains. Cardington soils are moderately well drained and gently sloping to moderately steep. Shoals soils are nearly level and somewhat poorly drained.

Cardington soils occupy 45 percent of the map unit; Shoals soils, 20 percent; and minor soils, 35 percent. Among the minor soils are Bogart, Jimtown, Chili, Bennington, Hennepin, and Alexandria.

Slope and a moderate to severe hazard of erosion are the major limitations of Cardington soils for farming and some nonfarm uses. Seasonal flooding and wetness are limitations of the Shoals soils, particularly for most nonfarm uses. Most nearly level and gently sloping areas of these soils are cultivated. Sloping and moderately steep areas are more commonly used for permanent pasture or woodland. Where slope is not a limitation, Cardington soils are suitable for many nonfarm uses because of moderately good natural drainage; however, moderately slow permeability severely limits some uses.

10. Glynwood-Lobdell

Gently sloping to moderately steep, moderately well drained soils formed in glacial till and nearly level, moderately well drained soils formed in alluvium

This map unit is on the stream valley sides and narrow flood plains in the western half of Crawford County. Most areas of this map unit are in the valleys along the Little Scioto and Sandusky Rivers and Brokensword Creek and their tributaries. The flood plains are comparatively narrow and vary from only a few hundred feet to as much as one-half mile in width. About 5 percent of the total land area in the county is in this map unit.

Glynwood soils formed in deposits of glacial till. They are on the hillsides and sides of stream valleys. Lobdell soils formed in loamy, stream deposited sediment. They are predominantly on the flood plains. Glynwood soils are gently sloping to moderately steep and are moderately well drained; Lobdell soils are nearly level and are moderately well drained.

Glynwood soils occupy 35 percent of the map unit; Lobdell soils, 15 percent; and minor soils, 50 percent. Among the minor soils are Shoals, Sloan, and Medway soils on flood plains; and, in a few places, small areas of Bogart, Jimtown, Chili, Blount, Hennepin, and Alexandria soils.

Slope and a moderate to severe hazard of erosion are the major limitations of Glynwood soils for farming and some nonfarm uses. Seasonal flooding is a limitation of the Lobdell soils, particularly for many nonfarm uses. Most of the gently sloping areas of Glynwood soils are cultivated. Sloping and moderately steep areas are more commonly used for permanent pasture or woodland. Many woodland areas on the flood plains are being cleared and used for corn, soybeans, wheat, and oats. Where slope is not a limitation, Glynwood soils are suitable for many nonfarm uses because of moderately good natural drainage; however, slow permeability severely limits these soils for some nonfarm uses.

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 a profile that is 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.

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, Chili loam, 0 to 2 percent slopes, is one of several phases within the Chili series.

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

A *soil complex* consists of areas of two or more soils that are so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area includes some of each of the two or more dominant soils, and the pattern and proportion are somewhat similar in all areas. Kibbie-Bennington complex, 2 to 6 percent slopes, 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. Urban land 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.

AdB—Alexandria silt loam, 2 to 6 percent slopes. This gently sloping, well drained soil is on ground moraines and end moraines. It formed in glacial till that has occasional thin layers of sand and gravel. Slopes are mainly convex, short, and uneven. Areas of this soil are irregular in size and shape.

Typically, the surface layer is dark grayish brown silt loam about 9 inches thick. The subsoil is about 33 inches thick. The upper part of the subsoil is dark brown loam, and the lower part is dark yellowish brown gravelly clay loam and has mottles below a depth of about 30 inches. The substratum is dense calcareous glacial till. To a depth of about 60 inches, it is loam and silt loam. Few to common pebbles are throughout the soil. Some areas of this soil have thin, intermittent layers of sandy loam or gravelly loam within a depth of 36 inches.

Included with this soil in mapping are small areas of Chili, Tuscola, and Cardington soils. Some areas have extensive layers of sand and gravel at a depth of 5 to 8 feet. Also included are small areas of the somewhat poorly drained Bennington soils and the very poorly drained Marengo soils in depressions. A few knolls are eroded and have a lighter colored, more gravelly surface layer.

This soil has moderate permeability. Available water capacity is moderate. Runoff is medium. Natural drainage is generally adequate for crop production, although there are brief periods of saturation during the dormant season. The root zone is moderately deep to glacial till. Reaction in the root zone is commonly neutral to strongly acid. Content of organic matter in the surface layer is moderately low.

Most areas of this soil are used for cropland. Corn, soybeans, small grain, and hay are the principal crops. Some areas are in native hardwood forest. This soil has good potential for cropland. It has moderate limitations for some urban development, but is more desirable for building sites. It has some restricted permeability but is better suited to septic tank absorption fields than most upland soils.

In addition to this soil needing fertilizer and lime, runoff is an important management concern. The silt loam surface layer is subject to crusting, which tends to decrease infiltration and increase runoff. Measures that shorten the length of slope, increase infiltration, and prevent raindrop impact on bare soil help reduce erosion. Where runoff collects in concentrated flow, reshaping the waterway and seeding close-growing grasses help filter sediment from runoff and prevent gully formation.

Cropland management that leaves plant residue on the surface should be used. Close-growing crops, including small grain and meadow, form ground cover and root systems that help hold soil in place during winter and spring. Plant residue, manure, and minimum tillage help maintain or improve soil structure in the plow layer. No-tillage can be effective where continuous row cropping is desired.

Woodland improvement for timber production requires exclusion of undesirable species and poorly formed trees. Where new trees are planted, competition from grasses and shrubs is a concern. This soil is well suited to such species as black walnut that grow well on moist, well drained soils.

Many desirable residential sites that have gently sloping terrain and are near streams are on this soil. Pond sites that use the natural terrain and watersheds are common. Site planning for a dwelling needs to include stockpiling surface soil for final grading, foundation drains to intercept seepage water and lower the seasonal water table, measures to control runoff during construction, and seeding establishment when construction is completed. This soil provides fair to good roadfill and reservoir embankments. High moisture content can restrict excavation during some parts of winter and spring. Capability subclass IIe; woodland suitability subclass 2o.

AdC2—Alexandria silt loam, 6 to 12 percent slopes, moderately eroded. This sloping, well drained soil is mainly on irregular hills and isolated knobs, but it is also along a few stream valleys. It formed in glacial till on hummocky end moraines and kames. Most areas are moderately eroded.

Typically, the surface layer is dark brown silt loam about 9 inches thick. The subsoil is about 27 inches thick. The upper part of the subsoil is dark brown loam, and the lower part is dark yellowish brown gravelly clay loam and has mottles below a depth of 30 inches. The substratum is calcareous glacial till. To a depth of about 60 inches, it is loam and silt loam. Pebbles are throughout the soil. Layers of friable sandy or gravelly loam are below 30 inches in many areas.

Included with this soil in mapping are areas of the somewhat poorly drained Bennington soils on the lower part of slopes and in springs and seeps; small areas of the very poorly drained Marengo soils along natural water courses; and small areas of soils that have a loam surface layer. Common severely eroded spots on knobs and steeper parts of this soil are shown on the soil map by severe sheet and rill erosion spot symbols.

This soil has moderate permeability. Available water capacity is moderate. Runoff is rapid. Natural drainage is generally adequate for crop production, although there are brief periods of saturation during the dormant season. The root zone is moderately deep to glacial till. Reaction in the root zone is commonly neutral to strongly acid. Content of organic matter in the surface layer is moderately low.

Most areas of this soil are used for cropland. Corn, soybeans, small grain, and hay are the principal crops. Some areas are in native hardwood forest.

This soil has fair to good potential for cropland if erosion is controlled. When this soil is cultivated, the surface layer forms a crust after rains and slopes tend to concentrate and accelerate runoff. Where water infiltration is less, moisture deficiencies can occur during dry seasons.

Erosion has removed part of the surface layer, and subsequent plowing has mixed some material from the more sticky subsoil with material from the surface layer. This soil has poorer tilth and slightly lower available water capacity than the less eroded Alexandria soils.

Minimum tillage and no-tillage are effective in controlling erosion. Grassed waterways help prevent gully erosion. The most severely eroded spots are difficult to vegetate. Planting trees can be an alternate land use, especially on severely eroded spots.

Because of good natural drainage and firm foundation material, this soil has good potential for homesites. Many desirable residential sites that have rolling terrain and are near streams are on these soils. Pond sites that use the natural terrain are also common. Buildings need to be carefully placed on the site to avoid blocking the natural surface drainageways. Controlling erosion during construction is important in preventing stream pollution. Capability subclass IIIe; woodland suitability subclass 2o.

AdD2—Alexandria silt loam, 12 to 18 percent slopes, moderately eroded. This moderately steep, well drained soil is mostly along stream valleys or natural water courses, but it is also on a few isolated hills. It formed in glacial till. This soil is moderately eroded.

Typically, the surface layer is dark brown silt loam about 7 inches thick. The subsoil is about 23 inches thick. The upper part of the subsoil is dark brown loam, and the lower part is dark yellowish brown gravelly clay loam. The substratum is calcareous glacial till. To a depth of about 60 inches, it is dense loam or silt loam. Pebbles are throughout the soil. Wooded areas have a very dark grayish brown surface layer. Some areas of this soil contain layers of gravelly sandy loam or sandy loam below a depth of 36 inches. The depth and thickness of these sandy or gravelly layers vary considerably within short distances.

Included with this soil in mapping are some severely eroded spots on knolls and the steeper parts of hills. These spots have a brown or yellowish brown surface layer and can be gravelly. They are shown on the soil map by severe sheet and rill erosion symbols. Also included are small areas of the very poorly drained Marengo soils in natural drainageways and areas that have a loam surface layer.

This soil has moderate permeability. Available water capacity is moderate. Runoff is very rapid. The root zone is moderately deep to glacial till. Reaction in the root zone is mainly slightly acid to strongly acid. Content of organic matter in the surface layer is moderately low.

Most areas of this soil are used for cropland, woodland, or pasture. This soil has poor potential for row crops and fair potential for hay and pasture. It has good potential for woodland.

The moderately steep slopes contribute to very rapid runoff when the soil is bare. The water has little chance to infiltrate, and this causes a droughty condition in dry seasons. Water from adjoining soils is concentrated in drainageways that can develop into gullies if the surface is unprotected. Grassed waterways and no-tillage or minimum tillage are effective in controlling erosion. The topsoil is commonly low in fertility and is acid. Careful management is needed to maintain productivity for cropland.

Moderately steep slopes are the major limitation for most intensive uses of this soil. Slope is less restrictive for such uses as woodland and wildlife habitat. This soil has moderately high productivity for timber and is well suited to upland game habitat. Many areas are scenic spots and have potential for hiking. Capability subclass IVe; woodland suitability subclass 2r.

BgA—Bennington silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on convex rises that are 1 to 2 feet higher than the nearby wetter soils. It formed in calcareous glacial till on the uplands. The till is predominantly shale but contains some sandstone, limestone, and crystalline rocks.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil between depths of about 8 and 42 inches is mottled, yellowish brown and dark brown silty clay loam and silty clay. The substratum to a depth of about 60 inches is dark grayish brown clay loam glacial till. A few shale, sandstone, and crystalline pebbles are throughout the soil.

Included with this soil in mapping are small areas of Condit and Marengo soils in slight depressions and on flats. Large areas of this Bennington soil in Auburn and Cranberry Townships are slightly lower in content of clay and higher in silt in the subsoil and are more deeply leached than other Bennington soils. These areas of soils also have a very firm and slowly permeable layer in the lower part of the subsoil.

This soil has moderately slow or slow permeability in the subsoil and slow permeability in the substratum. Available water capacity is moderate. Runoff is slow. The root zone is moderately deep if the soil is adequately drained. Reaction in the root zone ranges from very strongly acid in the upper part to mildly alkaline in the lower part. Content of organic matter in the surface layer is moderate.

Most areas of this soil are partly drained by subsurface and surface systems and are used as cropland. Corn, soybeans, small grain, and grass-legume meadow are the principal crops. A few areas are used for woodland or pasture. This soil has good potential for cropland.

Excess water during rainy periods is the main concern for most intensive uses of this soil. Low gradient and long distances to drainage channels prolong wetness. Subsurface drainage is effective in lowering the water table. Runoff is slow, and the hazard of erosion is slight. The silty surface layer is subject to crusting, which slows infiltration and can cause temporary ponding after heavy rains. Although available water capacity is moderate in the root zone, a shortage of water seldom limits plant growth where drainage has been improved.

This soil has severe limitations for most engineering uses, but it has fair to good potential for many of these uses if the water table is lowered by adequate surface and subsurface drainage. High frost action potential is a limitation for such structures as roads and foundations. Moderate shrink-swell potential is a limitation for some engineering uses. The glacial till below the subsoil is relatively dense and stable and has low compressibility. Capability subclass IIw; woodland suitability subclass 2w.

BgB—Bennington silt loam, 2 to 6 percent slopes. This gently sloping, somewhat poorly drained soil is mostly on end moraines and in scattered, mildly dissected areas on ground moraines. It formed in calcareous glacial till on the uplands. The till is predominately shale but contains some sandstone, limestone, and crystalline rocks.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil between depths of about 8 and 38 inches is mottled, yellowish brown and dark brown silty clay loam. The substratum to a depth of about 60 inches is dark grayish brown clay loam glacial till. A few pebbles are throughout the soil.

Included with this soil in mapping are narrow bands of Pewamo soils along natural drainage channels and small areas of Cardington soils on small knolls or ridges. Also included are some areas of this Bennington soil that are moderately eroded and have a more sticky surface layer and reduced tilth. Large areas of this Bennington soil in the northern and eastern parts of the county are slightly lower in clay content and more deeply leached than other Bennington soils. Where this soil is in areas of hummocky relief on end moraines, occasional layers of loamy and clayey stratification are in the subsoil, and soil properties are more variable than in areas on the nearby ground moraines.

This soil has moderately slow or slow permeability in the subsoil and slow permeability in the substratum. Available water capacity is moderate. Runoff is medium. The root zone is moderately deep if the soil is adequately drained. Reaction in the root zone ranges from very strongly acid in the upper part to mildly alkaline in the lower part. Content of organic matter in the surface layer is moderate.

Most areas of this soil are partly drained by subsurface and surface systems and are used as cropland. Corn, soybeans, small grain, and grass-legume meadow are the principal crops. A few areas are used for woodland or pasture. This soil has good potential for cropland.

A moderate hazard of erosion is the main management concern for farming. Excess water, however, is also a major limitation. Nearby higher elevations commonly contribute runoff and seepage to this soil. Surface water collects in well defined channels of flow. Minimum tillage, grassed waterways (fig. 1), and contour farming are used to help control erosion. Subsurface drainage systems are effective in lowering the water table. The slope of this soil can create problems in designing a drainage system. Although available water capacity is moderate in the root zone, a shortage of water seldom limits plant growth where drainage has been improved.

This soil has severe limitations for most engineering uses, but it has fair to good potential for many of these uses if the water table is lowered by adequate surface and subsurface drainage. High frost action potential is a hazard for such structures as roads and foundations. Moderate shrink-swell potential is a limitation for some engineering uses. The glacial till below the subsoil is relatively dense and stable and has low compressibility. Capability subclass IIe; woodland suitability subclass 2w.

BhB—Bennington-Urban land complex, undulating. This map unit consists of nearly level and gently sloping, somewhat poorly drained Bennington soils and areas of Urban land on smooth uplands. Slopes range from 0 to 6 percent. Most areas are in residential and business sections of the cities and in some small towns. This unit is about 55 percent Bennington soils and about 40 percent Urban land. Most areas have straight boundary lines and are rectangular in shape. The shape of areas is commonly determined by street and building designs. The Bennington soils are at the rear of lots, on undeveloped lots, or in openland.

Typically, the surface layer of the Bennington soils is dark grayish brown silt loam about 8 inches thick. The subsoil between depths of about 8 and 40 inches is mottled, yellowish brown and dark brown silty clay loam or silty clay. The substratum to a depth of about 60 inches is dark grayish brown clay loam glacial till. A few shale, sandstone, and crystalline pebbles are throughout the soil.

The Urban land part of this unit is covered by streets, parking lots, buildings, and other structures that obscure or alter the soils so that identification is not feasible. Typically, the surface of Urban land is covered with concrete, sand, or coarse limestone aggregate. Below this the soil material is neutral or moderately alkaline clay loam or silty clay loam. In some areas this soil material is the original subsoil or substratum, and in other areas it is fill material from nearby soils.

Included with this unit in mapping are some deeply disturbed, filled or truncated areas that are not covered by streets or buildings. Included with the Bennington soils are areas, near buildings and in small depressions, that contain as much as 2 feet of fill material over the original soil. Also included are small areas of Pewamo, Condit, and Luray soils in depressions and the better drained Cardington and Glynwood soils on knolls.

Bennington soils have a seasonal high water table that is perched over a slowly permeable substratum. Available water capacity is moderate in the root zone, but a shortage of water seldom limits plant growth where drainage has been improved. Content of organic matter in the surface layer is moderate. The surface layer is subject to crusting and erosion when it is left bare. High frost action potential and moderate shrink-swell potential must be considered in designing foundations for structures and roads. The glacial till substratum is relatively dense and has low compressibility.

Bennington soils have severe limitations for most uses because of the seasonal high water table and moderately slow to slow permeability. When drained, these soils are well suited to lawns and landscaping but are poorly suited to onsite sewage disposal.

Disturbed areas have poor conditions for plant growth. Although natural lime is commonly abundant, fertility and available water capacity are low. The root zone is shallow and is commonly very firm and compact. Runoff is very high, and the hazard of erosion is severe. The soil material has good strength when properly compacted. Blanketing disturbed areas with topsoil helps establish ground cover. Mulching and applying the proper fertilizer aid in establishing seedings. Capability subclass: Bennington soil in IIe, Urban land, not assigned; woodland suitability subclass: Bennington soil in 2w, Urban land, not assigned.

BoA—Blount silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on low crowns that are surrounded by the darker colored Pewamo soils or is on extensive upland flats that are intermingled with strings of Pewamo soils. This soil formed in glacial till on the uplands.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil between depths of about 8 and 30 inches is mottled, brown to dark yellowish brown silty clay loam, silty clay, and clay loam. The substratum to a depth of about 60 inches is mottled yellowish brown clay loam glacial till.

Included with this soil in mapping in more hummocky areas are spots of soils that are stratified in the lower part of the subsoil and substratum; in a few areas are sandy spots that resemble Kibbie or Jimtown soils; and in depressions and along drainageways are small areas of Pewamo soils. A few spots of Elliott soils are also included where this soil grades to Pewamo. Elliott and Pewamo soils make up less than 10 percent of most areas.

The root zone is moderately deep to glacial till. Available water capacity is moderate. This soil has slow or moderately slow permeability. Runoff is slow, and erosion is a hazard on long slopes. Reaction ranges from very strongly acid to slightly acid in the upper part of the soil and grades to mildly alkaline in the lower part. Content of organic matter in the surface layer is moderate.

Most areas of this soil are used for cropland. Minor acreages are in pasture and native woodland. This soil has good potential for cultivated crops and for most engineering uses if the water table is lowered by drainage.

The main concerns of management for farming are lowering the seasonal high water table, increasing infiltration rates, preventing soil compaction, and improving fertility. Systematic subsurface drainage is commonly used to lower the water table. Compaction occurs when heavy machinery is used on this soil during wet periods. Crusting and sealing of the surface layer after rain causes reduced infiltration. Management to maintain tilth includes minimum tillage, tillage at the proper moisture condition, and using deep-rooted legumes and grasses in rotation with cultivated crops.

The moisture regime is excess moisture or saturated conditions during the dormant season, gradual depletion during the early growing season, and a period of moisture stress late in summer. The rooting depth is influenced by the water table. Supplemental irrigation can be beneficial in increasing yields, but rainfall provides ample moisture during most seasons.

This soil has severe limitations for residential development. Building sites need to be landscaped for good surface drainage away from the foundations. Seasonal wetness and slow permeability make this soil poorly suited to septic tank absorption fields.

Woodland, wildlife habitat, and outdoor recreation are affected by the seasonal high water table. The water table limits the selection and growth of native plants, narrows some wildlife habitat, and limits the desirable periods when the soil is suited to such outdoor activity as camping or hunting. Capability subclass IIw; woodland suitability subclass 3w.

BoB—Blount silt loam, 2 to 6 percent slopes. This gently sloping, somewhat poorly drained soil is on the uplands. It formed in glacial till. Some areas have concave slopes that receive runoff from adjacent soils. Other areas are on convex knolls on ridges, and in these areas slopes are 4 to 5 percent. This soil is commonly in a band between Glynwood soils on knolls and Pewamo soils in depressions. It also is commonly at the head of minor drainageways where surface water begins to collect into channels.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil between depths of about 8 and 28 inches is mottled, brown to dark yellowish brown silty clay loam, silty clay, and clay loam. The substratum to a depth of about 60 inches is mottled, yellowish brown clay loam glacial till.

Included with this soil in mapping are spots of soils that are stratified in the lower part of the subsoil and substratum; in a few areas are sandy spots that resemble Kibbie or Jimtown soils; and in depressions and along drainageways are small areas of Pewamo soils. A few spots of Elliott soils are also included where this soil grades to Pewamo soils. Elliott and Pewamo soils make up less than 10 percent of most areas.

The root zone is moderately deep to glacial till. Available water capacity is moderate. This soil has slow or moderately slow permeability. Runoff is medium. The hazard of erosion is moderate, especially on long slopes. Reaction ranges from very strongly acid to slightly acid in the upper part of the soil and is mildly alkaline in the lower part. Content of organic matter in the surface layer is moderate.

Most areas of this soil are used for cropland. A minor acreage is in pasture and native woodland. This soil has good potential for cultivated crops and for most engineering uses if the water table is lowered by drainage.

The main concerns of management for farming are controlling erosion, lowering the seasonal high water table, increasing infiltration rates, preventing soil compaction, and improving fertility. Minimum tillage, sod waterways, and using meadow crops in the rotation are helpful in controlling erosion. Systematic subsurface drainage is commonly used to lower the water table. Compaction occurs when heavy machinery is used on this soil during wet periods. Crusting and sealing of the surface layer after rain cause reduced infiltration. Management to maintain tilth includes minimum tillage, tillage at the proper moisture content, and using deep-rooted legumes and grasses in rotation with cultivated crops.

The moisture regime is excess moisture or saturated conditions during the dormant season, gradual depletion during the early growing season, and a period of moisture stress late in summer. Lowering the seasonal water table improves deep root development. Supplemental irrigation can be beneficial in increasing yields, but rainfall provides ample moisture during most seasons.

This soil has severe limitations for residential development. Building sites need to be landscaped for good surface drainage away from the foundations. Seasonal wetness and slow permeability make this soil poorly suited to septic tank absorption fields.

Woodland, wildlife habitat, and outdoor recreation are affected by the seasonal high water table. The water table limits the selection and growth of native plants; narrows some wildlife habitat; and limits the desirable periods when the soil is suited to such outdoor activity as camping or hunting. Capability subclass IIe; woodland suitability subclass 3w.

BtA—Bogart loam, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on outwash plains, terraces, and end moraines. It formed in loamy outwash deposits. Most areas are level to slightly depressional except on end moraines where slopes are convex.

Typically, the surface layer is dark grayish brown loam about 8 inches thick. The subsoil is about 51 inches thick. The upper part of the subsoil is yellowish brown and dark yellowish brown loam and sandy clay loam and is mottled below a depth of 13 inches; the lower part is mottled, grayish brown loam. The substratum to a depth of about 75 inches is mottled, dark grayish brown loamy fine sand.

Included with this soil in mapping are the very poorly drained Olmsted and Colwood soils and some areas of soils in which glacial till is at a depth of 5 to 7 feet, and a seasonal water table is perched above the till. Also included are some areas of soils that have a gravelly surface layer.

This soil has moderate permeability in the subsoil and rapid permeability in the underlying coarse material. Runoff is slow, and the available water capacity is moderate. Tilth is generally good. The root zone is deep. Reaction in the root zone ranges from very strongly acid in the upper part to slightly acid in the lower part unless the soil has been limed. Content of organic matter in the surface layer is moderately low.

Most areas of this soil are used for cropland. Corn, soybeans, small grain, and hay are commonly grown. This soil has good potential for cropland and for most engineering uses except water impoundment.

Erosion is not a hazard where this soil is cultivated, and drainage is adequate for most crops. This soil is suited to early season crops, since it dries quickly after wet periods and warms up early in spring. Plants commonly show moisture stress on this soil in summer. The soil has good infiltration; therefore, it is well suited to irrigation.

Some desirable sites for development are on this soil. The soil is nearly level and provides good foundation material for building. Some seepage, however, can be expected below a depth of 3 or 4 feet. Foundation drains are needed to remove this excess water. Wetness is also a limitation to the use of septic tank absorption fields. Capability subclass IIs; woodland suitability subclass 1o.

BtB—Bogart loam, 2 to 6 percent slopes. This gently sloping, moderately well drained soil is on outwash plains, terraces, and end moraines. It formed in loamy outwash deposits. Most areas have convex slopes.

Typically, the surface layer is dark grayish brown loam about 7 inches thick. The subsoil is about 48 inches thick. The upper part of the subsoil is yellowish brown and dark yellowish brown loam and sandy clay loam and is mottled below a depth of 16 inches; the lower part is mottled, grayish brown sandy loam. The substratum to a depth of about 75 inches is mottled, dark grayish brown loamy fine sand.

Included with this soil in mapping are the somewhat poorly drained Jimtown soils and many areas of a soil in which glacial till is at a depth of 4 to 6 feet, and a seasonal water table is perched above the till. Also included are some areas of a soil that has a gravelly surface layer.

This soil has moderate permeability in the subsoil and rapid permeability in the underlying coarse material. Runoff is medium. Available water capacity is moderate. Tilth is generally good. The root zone is deep. Reaction in the root zone ranges from very strongly acid in the upper part to slightly acid in the lower part unless the soil has been limed. Content of organic matter in the surface layer is moderately low.

Most areas of this soil are used for cropland. Corn, soybeans, small grain, and hay are commonly grown. This soil has good potential for cropland and for most engineering uses except water impoundment.

The hazard of erosion is a moderate limitation for farming. Plant residue, manure, and minimum tillage help control erosion and maintain or improve tilth of the surface layer. No-tillage can be effective where continuous row cropping is used. Including meadow crops with cultivated crops in the rotation and using sod waterways also help control erosion.

Drainage is adequate for most crops. This soil is suited to early season crops, since it dries quickly after wet periods and warms up early in spring. Plants commonly show moisture stress on this soil in summer. The soil has a good infiltration rate; therefore, it is well suited to irrigation.

Some desirable sites for development are on this soil. The soil is gently sloping and provides good foundation material for buildings. Seepage, however, can be expected below a depth of 3 or 4 feet. Foundation drains are needed to remove this excess water. Wetness is also a limitation to the use of septic tank absorption fields. Capability subclass IIe; woodland suitability subclass 1o.

Bw—Bono silty clay loam. This nearly level, very poorly drained soil is mostly in well defined, local depressions or larger, nearly level basins. It formed in glacial lacustrine sediment.

Typically, the surface layer is black silty clay loam about 11 inches thick. The subsoil between depths of about 11 and 50 inches is mottled, gray, dark gray, yellowish brown, and brownish yellow silty clay and silty clay loam. The substratum to a depth of 70 inches is gray and yellowish brown loam and clay loam.

Included with this soil in mapping are small areas of Lenawee Variant, Pewamo, and Luray soils. Also included are areas that have an organic surface layer and many small areas, in the lower part of depressions, that are subject to ponding.

This soil is one of the wettest of the mineral soils in the county. Even in dry seasons, the water table drops only a few inches below the surface in undrained areas. The root zone is deep in drained areas, plastic when wet, and slowly permeable. Reaction is neutral or slightly acid in the upper part of the root zone and neutral or mildly alkaline in the lower part. Available water capacity is moderate, but crops seldom show moisture stress. Content of organic matter in the surface layer is high. Base exchange capacity is also high.

Many areas of this soil are undrained because excavation needed to obtain subsurface outlets is costly. Areas that have been drained are used mainly for cropland and have good potential for this use. This soil has poor potential for most other uses. Drainage is the most effective means of improving crop production on this soil. Surface drains are often not feasible, but subsurface drains designed to handle surface and internal water can be effective in many areas. Improving nearby ditch channels is needed to obtain drainage outlets. Tillage should be avoided when this soil is wet in order to prevent cloddiness and compaction. Shrinkage cracks (fig. 2) form when the soil dries. Tillage in fall is widely used with little erosion loss.

Because of swampiness, pasture is poor in undrained areas of this soil. By enhancing natural water ponding on this soil, the potential is good for wetland wildlife habitat. Woodland production is limited to such water-tolerant species as swamp white oak, pin oak, cottonwood, or red maple. The high water table and high shrink-swell potential are severe limitations for most engineering uses. Capability subclass IIIw; woodland suitability subclass 3w.

CdB—Cardington silt loam, 2 to 6 percent slopes. This gently sloping, moderately well drained soil is on low knolls or ridges on end moraines. It formed in glacial till.

Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The subsoil is about 35 inches thick and is mostly firm or very firm silty clay loam. The subsoil is yellowish brown in the upper part and dark yellowish brown in the lower part. It has mottles and is gray below a depth of 10 inches. The substratum to a depth of about 68 inches is dark brown silt loam. Some hummocky areas near Alexandria and Marengo soils have a more variable texture in the subsoil.

Included with this soil in mapping are small areas of the somewhat poorly drained Bennington soils in low spots and around the base of knolls; areas of the very poorly drained Pewamo and Marengo soils along drainageways; and many areas of this Cardington soil which have a more porous substratum and better permeability. Also included, southeast of Galion, are soils that have a fragipan in the subsoil.

This soil has moderately slow permeability. Available water capacity is moderate. Runoff is medium. Content of organic matter in the surface layer is moderate. Tilth is good. The root zone is deep. Reaction is medium acid to very strongly acid in the upper part. This soil becomes less acid as depth increases, and natural lime is present deep in the soil. A perched water table is in the subsoil during winter and spring. Natural drainage, however, is generally adequate for most crops.

Most areas of this soil are used as cropland. Corn, soybeans, small grain, and hay are the principal crops. This soil has good potential for these uses, if properly managed. It also has good potential for most recreational uses and for pasture, woodland, and openland or woodland wildlife. It has fair potential for homesites.

The hazard of erosion is moderate where this soil is cultivated. Minimum tillage, winter cover crops, and grassed waterways help prevent excessive soil loss. Contour cropping or stripcropping should be used in many areas. Returning crop residue or adding other organic material to the soil helps to improve fertility, reduce crusting, and increase water infiltration. Natural drainage is generally adequate for farming, but random tile lines are beneficial in draining wet spots along waterways and in depressions. Maintaining fertility and organic matter, and controlling erosion are the main management concerns.

This soil is well suited to a variety of pasture crops, but rarely is used as permanent pasture because of its suitability for cropland.

This soil is well suited to trees, and a few small areas are in native hardwoods. Where new plantings are made, competition from grasses and shrubs is a concern.

This soil is firm and compact and makes good foundation material and fill for dams. It is too clayey to be good roadfill. Seasonal wetness is a moderate to severe limitation for homesites. Installing footer drains and selecting high, convex spots for building overcome wetness in some areas. Specially designed septic tank absorption fields should be installed. Areas of the included wetter soils should be avoided in building. Capability subclass IIe; woodland suitability subclass 2o.

CdB2—Cardington silt loam, 2 to 6 percent slopes, moderately eroded. This gently sloping, moderately well drained soil is mainly on low knolls or ridges on end moraines. It formed in glacial till.

Typically, the surface layer is dark brown silt loam about 7 inches thick. The subsoil is about 32 inches thick and is mostly firm or very firm silty clay loam. It is yellowish brown in the upper part, dark yellowish brown in the lower part, and is mottled below a depth of 10 inches. The substratum to a depth of about 68 inches is dark brown silt loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Bennington soils in low spots and around the base of knolls and areas of the very poorly drained Pewamo and Marengo soils along drainageways. Also included are some areas of severely eroded soils and many areas of the Cardington soil that have a more porous substratum and better permeability. Some hummocky areas near Alexandria and Marengo soils have a more variable texture in the subsoil.

This soil has moderately slow permeability. Available water capacity is moderate. Runoff is medium. Content of organic matter in the surface layer is moderate to low. Tilth is fair. The root zone is deep. Reaction is medium acid to very strongly acid in the upper part of the soil; however, this soil becomes less acid as depth increases, and natural lime is present deep in the soil. A perched water table is in the subsoil during winter and spring. Natural drainage, however, is generally adequate for most crops.

Most areas of this soil are used as cropland. Corn, soybeans, small grain, and hay are the principal crops. This soil has good potential for these uses, if properly managed. It also has good potential for most recreational uses and for pasture, woodland, and openland or woodland wildlife. It has fair potential for homesites.

Past erosion has reduced the thickness of the surface layer, and subsequent plowing has mixed subsoil material into the plow layer. This has lowered the organic-matter content of the surface layer, reduced the tilth, and slightly lowered available water capacity. This soil is very susceptible to crusting after heavy rain. It has a moderate hazard of additional erosion when cultivated. Minimum tillage, winter cover crops, and grassed waterways help control runoff. Contour cropping or stripcropping should be used in many areas. Returning crop residue or adding other organic material to the soil helps to improve tilth and fertility and to increase water infiltration. Natural drainage is generally adequate for farming, but random tile lines are beneficial in draining wet spots along waterways and in depressions. Maintaining fertility and organic matter levels and controlling erosion are the main management concerns.

The soil is well suited to a variety of pasture crops, but rarely is used as permanent pasture because of its suitability for cropland.

This soil is well suited to trees, and a few small areas are in native hardwoods. Where new plantings are made, competition from grasses and shrubs is a concern.

This soil is firm and compact and makes good foundation material and fill for dams. It is too clayey to be good roadfill. Seasonal wetness is a moderate to severe limitation for homesites. Installing footer drains and selecting high, convex spots for building overcome wetness in some areas. Specially designed septic tank absorption fields should be installed. Areas of wetter soils should be avoided in building. Capability subclass IIe; woodland suitability subclass 2o.

CdC2—Cardington silt loam, 6 to 12 percent slopes, moderately eroded. This sloping, moderately well drained soil is on knolls or ridges of hummocky end moraines and on valley slopes near small streams. It formed in glacial till.

Typically, the surface layer is dark brown silt loam about 6 inches thick. The subsoil is about 30 inches thick and is mostly firm or very firm silty clay loam. The subsoil is yellowish brown in the upper part and dark yellowish brown in the lower part. It has gray mottles below a depth of 10 inches. The substratum to a depth of about 60 inches is dark brown silt loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Bennington soils in low spots and around the base of knolls; areas of the very poorly drained Pewamo and Marengo soils along drainageways; spots of severely eroded soils; and many areas of a Cardington soil that has a more porous substratum and better permeability than this soil. Also included, southeast of Galion, are soils that have a fragipan in the subsoil. In some hummocky areas this soil has less clay in the subsoil.

This soil has moderately slow permeability. Available water capacity is moderate. Runoff is rapid. Content of organic matter in the surface layer is moderate to low. Tilth is fair. The root zone is moderately deep to glacial till. Reaction is medium acid to very strongly acid in the upper part of the soil. This soil becomes less acid as depth increases, and natural lime is present deep in the soil. A perched water table is in the subsoil during winter and spring. Natural drainage, however, is generally adequate for most crops.

Most areas of this soil are used as cropland. Corn, soybeans, small grain, and hay are the principal crops. This soil has good potential for these uses, if properly managed. It also has good potential for pasture, woodland, and openland or woodland wildlife. It has fair potential for homesites and for most recreational uses.

Erosion has reduced the thickness of the surface layer, and subsequent plowing has mixed subsoil material into the plow layer. This has lowered the organic-matter content of the surface layer, reduced the tilth, and slightly lowered available water capacity. This soil is very susceptible to crusting after heavy rain. There is a severe hazard of additional erosion when this soil is cultivated. Minimum tillage or no-tillage, winter cover crops, and grassed waterways help control runoff and reduce further erosion. Contour cropping or stripcropping should be used in many areas. Returning crop residue or adding other organic material to the soil helps to improve tilth and fertility and to increase water infiltration. Natural drainage is generally adequate for farming, but random tile lines are beneficial in draining wet spots along waterways. Maintaining lime, fertility, and organic matter levels and controlling erosion are the main management concerns.

This soil is well suited to a variety of pasture crops when properly managed. It is also well suited to trees, and a few areas are in native hardwoods. Where new plantings are made, competition from grasses and shrubs is a concern.

This soil is firm and compact and makes good foundation material and fill for dams. It is too clayey to be good roadfill. Seasonal wetness is a moderate to severe limitation for homesites. Installing footer drains and selecting high, convex spots for building overcome wetness in some areas. Septic tank absorption fields should be designed to overcome the limitations of slope and moderately slow permeability. Areas of wetter soils should be avoided in building. Capability subclass IIIe; woodland suitability subclass 2o.

CdD2—Cardington silt loam, 12 to 18 percent slopes, moderately eroded. This moderately steep, moderately well drained soil is on uplands along the major stream valleys and on the most irregular and hummocky sections of end moraines. It formed in glacial till.

Typically, the surface layer is dark brown silt loam about 6 inches thick. The subsoil is about 28 inches thick and is mostly firm or very firm silty clay loam. It is yellowish brown in the upper part, dark yellowish brown in the lower part, and mottled with gray below a depth of 12 inches. The substratum to a depth of about 60 inches is dark brown, calcareous silt loam.

Included with this soil in mapping are many areas of soils that have a more porous substratum and better permeability than this soil, a few areas of the wetter Bennington soils along drainageways, and some areas of severely eroded soils. In some hummocky areas this soil has less clay in the subsoil.

This soil has moderately slow permeability. Available water capacity is moderate. Runoff is very rapid. Content of organic matter in the surface layer is moderate to low. Tilth is fair. The root zone is moderately deep to glacial till. Reaction is medium acid to very strongly acid in the upper part of the soil. This soil becomes less acid as depth increases, and natural lime is present deep in the soil. It has a perched water table in the subsoil during winter and spring. Natural drainage, however, is generally adequate for most crops.

Most areas of this soil are used as cropland. Corn, small grain, and hay are the principal crops. This soil has fair potential for cropland if erosion is controlled. It has good potential for pasture, woodland, and openland or woodland wildlife. It has fair to poor potential for homesites and most recreational uses.

Erosion has reduced the thickness of the surface layer, and subsequent plowing has mixed subsoil material into the plow layer. This has lowered the organic-matter content of the surface layer, reduced the tilth, and slightly lowered the available water capacity. This soil is very susceptible to crusting after heavy rain. There is a severe hazard of additional erosion when this soil is cultivated. Minimum tillage or no-tillage, winter cover crops, stripcropping, and grassed waterways help control runoff and reduce erosion. In some areas, slopes are too short or irregular for contour stripcropping. Returning crop residue or adding other organic material to the soil helps to improve tilth and fertility and to increase water infiltration. Natural drainage is generally adequate for farming, but random tile lines are beneficial in draining wet spots along waterways. Maintaining lime, fertility, and organic matter levels and controlling erosion are the main management concerns.

This soil is well suited to a variety of pasture crops when properly managed. It is also well suited to trees, and a few small areas are in native hardwoods. Where new plantings are made, competition from grasses and shrubs is a concern.

This soil is firm and compact and makes good foundation material and fill for dams. It is too clayey to be good roadfill. Moderately steep slopes are a severe limitation for homesites. Seasonal wetness is a limitation for homes with basements. Septic tank absorption fields need special design to overcome the severe limitations of slope and permeability. Capability subclass IVe; woodland suitability subclass 2r.

CeC—Cardington-Urban land complex, rolling. This map unit consists of moderately well drained Cardington soils and areas of Urban land. It is on uplands. Slopes are mainly 6 to 12 percent. Most areas are in the business and residential sections of the cities and in some small towns. This unit is about 55 percent Cardington silt loam and about 40 percent Urban land. Most areas have straight boundary lines and are rectangular in shape. Shape is commonly determined by street and building design. The Cardington soils are at the rear of lots, on undeveloped lots, or in other openland.

Typically, the surface layer of Cardington soils is dark brown silt loam about 7 inches thick. The subsoil is about 35 inches thick and is mostly silty clay loam. It is yellowish brown in the upper part, dark yellowish brown in the lower part, and mottled with gray below a depth of about 10 inches. The substratum to a depth of about 60 inches is dark brown silt loam.

The Urban land part of this unit is covered by streets, parking lots, buildings, and other structures that obscure or alter the soils so that identification is not feasible. Typically, the surface of Urban land has a layer of concrete, sand, or coarse limestone aggregate. Below this the soil material is neutral to moderately alkaline clay loam or silty clay loam. In some areas this soil material is the original subsoil or substratum, and in other areas it is fill material from nearby soils.

Included with this unit in mapping are some deeply disturbed, filled or truncated areas that are not covered by streets or buildings. Included with the Cardington soils are areas, near buildings and in ravines, that have as much as 2 feet of fill material over the original soil. Small areas of Shoals soils along streams and spots of the well drained Alexandria and Chili soils on knolls are also included.

The Cardington soils have moderately slow permeability and moderate available water capacity. Content of organic matter in the surface layer is moderate. The root zone is deep. Reaction is medium acid to very strongly acid in the upper part of the soil. The soil becomes less acid as depth increases, and natural lime is present deep in the soil. A perched water table is in the subsoil during winter and spring. Natural drainage, however, is generally adequate for most plants.

The Cardington soils are susceptible to crusting and erosion when left bare. High frost action potential and moderate shrink-swell potential must be considered in designing foundations for structures and roads. The glacial till substratum is relatively dense and has low compressibility. These soils have moderate to severe limitations for most uses because of the seasonal water table and moderately slow permeability.

Disturbed areas have poor conditions for plant growth. Although natural lime is commonly abundant, fertility and available water capacity are low. The root zone is shallow and is commonly very firm and compact. Runoff is very high, and the hazard of erosion is severe. The soil material has good strength when properly compacted. Blanketing disturbed areas with topsoil helps establish ground cover. Mulching and applying proper fertilizer help establish seedings. Capability subclass: Cardington soils in IIIe, Urban land, not assigned; woodland suitability subclass: Cardington soils in 2o, Urban land, not assigned.

Ck—Carlisle muck. This level, very poorly drained soil formed in muck and peat deposits that are more than 4 feet thick. These organic deposits are derived from grasses, sedges, reeds, and woody material that accumulated in bogs. In most undrained areas water is ponded in winter and spring.

Typically the Carlisle soil in a cultivated area is black muck to a depth of 7 inches. Below this, to a depth of 60 inches, is dark brown or very dark brown muck.

Included with this soil in mapping are small areas of Muskego soil. Also included are spots near the edge of most areas where the muck is less than 51 inches thick.

This soil has moderately rapid permeability. The root zone is deep. Available water capacity is very high in drained areas. Content of organic matter is very high throughout. The water table is at or near the surface for extended periods, under natural conditions.

This soil is well suited to most locally grown crops and some specialty crops if adequately drained. It has good potential for these uses, but it has poor potential for most engineering uses. Some large areas of this soil and a few small areas have been drained by tile and are used for vegetable and field crops. Many small areas are undrained and remain covered with such native bog plants as cattail, sedges, and swamp shrubs.

Artificial drainage is essential for the production of crops. Outlets are expensive to construct and maintain in most places. Ditchbanks are unstable. Subsidence caused by drainage results in tile displacement. Because of looseness, soil blowing is a major hazard in the larger drained areas.

The loose, porous surface layer of this soil is easily tilled. It commonly needs compaction rather than loosening to create a good seedbed. The high content of organic matter makes the soil very absorbent of water and nutrients. Trace element deficiencies are more common in this soil than in mineral soils.

This soil is well suited to irrigation if an adequate drainage system is installed. Subirrigation through tile lines by controlling the water table is feasible. Because of the low position of this soil on the landscape, plants that grow on it are more susceptible to frost than those that grow in nearby soils. In large areas, windbreaks or ground cover are needed to control soil blowing. Controlling the level of the water table in this soil helps control rapid subsidence, burning, and blowing. Weed control is a special concern because herbicides need to be applied at a higher rate than usual to be effective.

Extreme wetness makes this soil unsuited to woodland, but the soil is excellent for wetland wildlife. This soil is highly valued in some places for sod production since a dense sod develops quicker than on mineral soils and it has less weight for shipment.

This soil is poorly suited to residential or commercial uses. Because of the high water table and high content of organic matter, this soil has low strength and low compressibility. Where this soil must be used for a structure site, a piling or floating type foundation is suggested. Earthfill can be placed at the edge of the muck and gradually can displace the less dense organic layers. Capability subclass IIIw; woodland suitability subclass 4w.

CnA—Chili loam, 0 to 2 percent slopes. This nearly level, well drained soil is loamy and contains some gravel. It is on terraces and deltas. It formed in gravelly outwash deposits.

Typically, the surface layer is dark grayish brown loam about 8 inches thick. The subsoil is about 40 inches thick. It is dark brown and brown and grades from loam in the upper part to gravelly clay loam and sandy loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown fine sandy loam and gravelly loam.

Included with this soil in mapping are small areas of Tuscola, Alexandria, and Bogart soils that have no definite pattern or arrangement. In areas adjacent to glacial till derived soils, this Chili soil has dense glacial till below a depth of 4 to 5 feet. Also included are some areas in which texture of the surface layer of this soil varies within short distances and is silt loam and sandy loam in places.

This soil has moderately rapid permeability. Available water capacity is moderate. Runoff is slow, and much rainfall infiltrates the soil. Tilth is good, and shrink-swell potential is low. The root zone is deep. Reaction in the root zone ranges from very strongly acid to slightly acid, unless the soil has been limed. Content of organic matter in the surface layer is moderately low.

This soil is used mostly for cropland. It has good potential for most crops, pasture, woodland, homesites, and many other nonfarm uses. It has fair to poor potential for uses that require water impoundment, such as ponds and lagoons. This soil is favorable for irrigation, filtration, and ground water recharge systems.

Erosion is not a hazard where this soil is cultivated. Plants commonly show moisture stress during summer. Such early season crops as oats or winter wheat produce quite well, as do vegetable crops that can be planted early. The soil has good infiltration; therefore, it is well suited to irrigation. Frost heaving is seldom a concern for such deep-rooted perennials as alfalfa. Lack of moisture during summer in some years is the only limitation for pasture and tree growth.

This soil is one of the most desirable in the county for development. It is nearly level, lacks seasonal wetness, and provides good foundation material for building. In some areas, seepage can be expected below a depth of 3 or 4 feet. Foundation drains, however, remove this excess water. This soil is well suited to onsite disposal of sewage effluent except in areas of wetter soils. It is a good source of roadfill. Capability subclass IIs; woodland suitability subclass 2o.

CnB—Chili loam, 2 to 6 percent slopes. This gently sloping, well drained soil is loamy and contains some gravel. It is on terraces, kames, and deltas. It formed in gravelly outwash deposits.

Typically, the surface layer is dark grayish brown loam about 8 inches thick. The subsoil is about 35 inches thick. It is dark brown and brown and grades from loam in the upper part to gravelly clay loam and sandy loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown fine sandy loam and gravelly loam.

Included with this soil in mapping are small areas of Alexandria soils. In areas adjacent to glacial till-derived soils, this Chili soil has dense glacial till below a depth of 3 to 5 feet. Also included are a few areas in which this soil is moderately eroded and some areas in which texture of the surface layer varies within short distances and is silt loam and sandy loam in places.

This soil has moderately rapid permeability. Available water capacity is moderate. Runoff is medium. Tilth is good, and shrink-swell potential is low. The root zone is deep. Reaction in the root zone ranges from very strongly acid to slightly acid, unless the soil has been limed. Content of organic matter in the surface layer is moderately low.

This soil is used mostly for cropland. It has good potential for most crops, pasture, woodland, homesites, and many other nonfarm uses. It has fair to poor potential for uses that require water impoundment, such as ponds and lagoons. This soil is favorable for irrigation, filtration, and ground water recharge systems.

Erosion is a moderate hazard where this soil is cultivated. Measures to shorten length of slope, increase infiltration, and prevent raindrop impact on bare soil help reduce erosion. Where runoff collects in concentrated flow, reshaping the waterway and seeding permanent close-growing grasses help filter sediment from runoff and prevent gully formation. Tillage practices that leave the surface rough and partly covered with plant residue are helpful. Close-growing crops, including small grain and meadow, form ground cover and root systems that hold the soil in place during winter and spring. Plant residue, manure, and mimumum tillage maintain or improve soil structure in the plow layer. No-tillage is effective on this soil.

Plants commonly show moisture stress during summer. Such early season crops as oats or winter wheat produce quite well, as do vegetable crops that can be planted early. This soil has good infiltration rates; therefore, it is well suited to irrigation if runoff is controlled. Frost heaving is seldom a concern for such deep-rooted perennials as alfalfa. Lack of moisture during summer in some years is a limitation for pasture and tree growth.

This soil has many desirable sites for development. Site planning for a dwelling needs to include stockpiling surface soil for final grading, foundation drains to intercept seepage water, and measures to control runoff during construction to prevent sedimentation of storm sewers and streams. It also needs to include grading to remove surface water and seeding establishment when construction is completed. This soil is well suited to onsite disposal of sewage effluent. It is a good source of roadfill. Capability subclass IIe; woodland suitability subclass 2o.

CnC2—Chili loam, 6 to 12 percent slopes, moderately eroded. This sloping, well drained soil is loamy and contains some gravel. It formed in gravelly outwash deposits. It is on terraces, kames, and deltas.

Typically, the surface layer is brown loam about 6 inches thick. The subsoil is about 32 inches thick. It is dark brown and brown and grades from loam in the upper part to gravelly clay loam and sandy loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown fine sandy loam and gravelly loam. The sand and gravel underlying this soil is commonly less than 60 inches thick.

Included with this soil in mapping are small areas of the more clayey Alexandria soils. In areas that are adjacent to soils formed in glacial till, this Chili soil has dense glacial till below a depth of 3 to 5 feet. Also included are some areas in which texture of the surface layer varies within short distances and is silt loam, gravelly loam, and sandy loam in places.

This soil has moderately rapid permeability. Available water capacity is moderate. Runoff is rapid. Tilth is good, and shrink-swell potential is low. The root zone is deep. Reaction in the root zone ranges from very strongly acid to slightly acid, unless the soil has been limed. Content of organic matter in the surface layer is moderately low.

This soil is used mostly for cropland or pasture. It has fair potential for most crops and good potential for pasture and woodland. It has fair to good potential for homesites and most engineering uses. Slope is the main limitation. The potential is poor for uses that require water impoundment, such as ponds and lagoons, because of seepage.

Erosion is a severe hazard where this soil is cultivated. Measures to shorten the length of slope, increase infiltration, and prevent raindrop impact on bare soil help reduce erosion. Where runoff collects in concentrated flow, reshaping the waterway and seeding permanent close-growing grasses help filter sediment from runoff and prevent gully formation. Tillage practices that leave the surface rough and partly covered with plant residue are helpful. Close-growing crops, including small grain and meadow, form ground cover and root systems that hold the soil in place during winter and spring. Plant residue, manure, and minimum tillage maintain or improve soil structure in the plow layer. No-tillage is effective on this soil.

Plants commonly show moisture stress during summer. Such early season crops as oats or winter wheat produce quite well. Frost heaving is seldom a concern for such deep-rooted perennials as alfalfa. Lack of moisture during summer in some years is the only limitation for pasture and tree growth.

The potential of this soil for residential use is better than that of most soils in the county because of good drainage and firm foundation material. This soil has many desirable residential sites that have rolling terrain and are near streams. Slope and the hazard of erosion are the main limitations for homesite use. Buildings need to be carefully placed on the site to avoid blocking runoff from other soils. Controlling erosion during construction is important. Slope should be considered in designing onsite sewage disposal systems. This soil is a good source of roadfill. Capability subclass IIIe; woodland suitability subclass 2o.

CnD2—Chili loam, 12 to 18 percent slopes, moderately eroded. This moderately steep, well drained soil is loamy and contains some gravel. It formed in gravelly outwash deposits. It is on terraces and deltas.

Typically, the surface layer is dark brown loam about 5 inches thick. The subsoil is about 30 inches thick. It is dark brown and brown and grades from loam in the upper part to gravelly clay loam and sandy loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown fine sandy loam and gravelly loam.

Included with this soil in mapping are small areas of Alexandria soils. In areas that are adjacent to soils formed in glacial till, this Chili soil has dense glacial till below a depth of 2 to 5 feet. Also included are some areas in which texture of the surface layer varies within short distances and is silt loam, gravelly loam, and sandy loam in places.

This soil has moderately rapid permeability. Available water capacity is moderate. Runoff is very rapid, and shrink-swell potential is low. The root zone is deep. Reaction in the root zone ranges from very strongly acid to slightly acid, unless the soil has been limed. Content of organic matter in the surface layer is moderately low. Occasional springs and seep spots are present.

Most areas of this soil are used for permanent pasture. This soil has fair potential for pasture and woodland but poor potential for more intensive uses. Slope is the main limitation for most uses. The hazard of erosion is very severe where this soil is cultivated, and careful planning for erosion control is needed. Lack of moisture during summer in some years is a limitation for pasture and tree growth.

The slope limits the use of this soil for homesites and onsite sewage disposal. Practices are needed to control erosion during construction. Capability subclass IVe; woodland suitability subclass 2r.

Co—Colwood silt loam. This nearly level, very poorly drained soil is mainly in slight depressions. It formed in loamy stratified sediment along the margin of glacial lake plains. It is not extensive and generally does not dominate the local landscape.

Typically, the surface layer is very dark gray silt loam about 13 inches thick. The subsoil is about 28 inches thick. The upper part is mottled, gray silty clay loam and clay loam, and the lower part is mottled, grayish brown fine sandy loam. The substratum to a depth of about 70 inches is mottled, gray and dark brown, stratified silty clay loam to loamy sand.

Included with this soil in mapping are small areas of Kibbie, Tuscola, Jimtown, Bogart, Olmsted, and other soils that formed in stratified materials. Also included are Bono soils in the larger depressions and Pewamo soils in areas where glacial till is within a few feet of the surface. A few small areas of soil that are in the lower part of depressions and are subject to ponding are also included.

This soil has moderate permeability. Available water capacity is high. Content of organic matter in the surface layer is high. The root zone is deep in drained areas. Reaction is slightly acid to mildly alkaline in the upper part of the subsoil and neutral to moderately alkaline in the lower part. The water table is near the surface during most of the year, unless drained, and the lowest areas of this soil are subject to ponding after heavy rain.

Most areas of this soil are used for cropland. This soil has good potential for most locally grown crops and some specialty crops. With good management, high crop production can be expected. This soil has fair to poor potential for most engineering uses.

Most areas of this soil have been artificially drained by subsurface drains that have open ditch outlets. Subsurface and surface drainage is effective in removing excess water. With improved drainage, this soil is one of the most productive in the county for a wide variety of crops. Without improved drainage, it remains waterlogged and soft, and planting and harvesting are delayed by wetness.

The use of this soil for a homesite requires careful planning to remove excess water. Tree shrub and grass species selected for planting should be tolerant of wetness. Capability subclass IIw; woodland suitability subclass 2w.

Cr—Condit-Bennington silt loams. These nearly level, poorly drained and somewhat poorly drained soils are in low-lying areas on till plains. Condit soils are commonly near the center of most areas, and Bennington soils are on low knolls on the fringes of areas. These soils formed in clay loam glacial till. This map unit is about 50 percent Condit soils and 30 percent Bennington soils. Minor soils make up the remaining 20 percent. The areas of these soils are so intricately mixed that it was not feasible to map them separately.

Typically, the Condit soils have a dark grayish brown silt loam surface layer about 9 inches thick. The subsoil between depths of about 9 and 52 inches is mottled, dark gray and yellowish brown silty clay loam. The substratum to a depth of about 70 inches is mottled, dark brown silty clay loam glacial till.

Typically, the Bennington soils have a dark grayish brown silt loam surface layer about 9 inches thick. The subsoil between depths of about 9 and 45 inches is mottled, yellowish brown and dark brown silty clay loam and silty clay. The substratum to a depth of about 60 inches is dark brown clay loam glacial till.

Included with these soils in mapping are spots of Pewamo soils that have a dark colored surface layer and are mainly in depressions near the center of most areas; a few areas of soils that have pockets of silt or gravel below a depth of 3 feet; and spots of soils that have a surface layer of very dark grayish brown silty clay loam. Also included are extensive areas of soils that are associated with Pewamo soils and have a dark surface layer, a higher content of organic matter, less acidity, and better tilth than is typical of these Condit and Bennington soils.

These soils have slow permeability. Available water capacity is moderate. The root zone is moderately deep in drained areas. Runoff is very slow, and some areas are ponded for short periods in winter and spring.

These soils are mostly used for cropland. Corn, soybeans, wheat, and meadow are the main crops. A few areas of these soils are in woodland, but they are gradually being cleared and drained. These soils are poorly suited to septic tank absorption fields.

Excess water and a slowly permeable subsoil are limitations for most farm and engineering uses. When drained, these soils have good potential for cropland and poor potential for homesites. Subsurface drainage is effective in lowering the water table; however, drainage outlets of sufficient depth are not always available.

High frost action potential is a concern for such structures as roads and foundations. Moderate shrink-swell potential is a limitation for some engineering uses. The glacial till below the subsoil is relatively dense and stable and has low compressibility. Capability subclass IIw; woodland suitability subclass 2w.

DeA—Del Rey silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on broad flats of former lake basins. It formed in laminated silt and clay sediment in former glacial lakes.

Typically, the surface layer is grayish brown silt loam about 10 inches thick. The subsoil is silty clay loam and silty clay about 36 inches thick. It is mottled, dark yellowish brown in the upper part and mottled gray in the lower part. The substratum to a depth of about 72 inches is mottled, grayish brown, laminated silt loam and very fine sand. In a few places, this soil has silty clay in the subsoil and substratum.

Included with this soil in mapping are areas of Tiro and Fitchville soils, particularly where this soil is near areas of Tiro and Fitchville soils.

This soil has slow permeability. Available water capacity is high. Runoff is slow. The root zone is deep. Content of organic matter in the surface layer is moderate. Reaction in the root zone is mostly slightly acid or neutral below the surface layer.

Most areas of this soil are used for cropland. A small acreage is in pasture or woodland. This soil has good potential for cultivated crops and for some engineering uses if it is drained. The hazard of wetness is moderate for farming. Surface and subsurface drainage is effective in removing excess water.

This soil responds well to management that controls runoff, lowers the seasonal water table, increases infiltration, prevents soil compaction, and improves nutrient availability. If the soil is cultivated, a dense surface crust forms after heavy rain. This is because the content of silt is high in the surface layer. Surface crusting lowers infiltration and increases runoff and erosion. This soil is commonly wet during winter and the early part of the growing season, restricting the depth of root development. Moisture stress can result later in the growing season. Artificial drainage is needed; however, this soil commonly remains wet longer than nearby Pewamo soils even if it is drained.

Wetness in this soil is a hazard to residential development. Drainage improves the strength and workability of this soil. Adequate surface water management and foundation drainage are needed around most structures. Seasonal wetness and restricted permeability limit this soil for use as septic tank absorption fields.

Woodland, wildlife, and outdoor recreation uses are affected in various ways by the seasonal high water table. Wetness limits the kinds and growth characteristics of native plant species, limits upland wildlife habitat, and restricts uses for camping and hunting. Capability subclass IIw; woodland suitability subclass 3w.

Du—Dumps. These areas of nonsoil material range from 2 to more than 20 feet in thickness. Most are low areas that have been filled or are trench landfills.

Bricks, concrete, paper, wood, glass, plastic, rubber, iron, steel, aluminum, ceramic, cinders, industrial waste, sewage sludge, soda ash residue, garbage, and manure are among the diverse materials in these areas. Some areas are made up mostly of one kind of waste material while others include several kinds. Earthfill is often intermixed to partly cover the wastes and form an even surface for vehicular traffic. Sanitary landfill sites are specially designed for receiving such wastes and generally contain about equal amounts of earthfill and refuse in compacted layers.

Some areas are along streambanks and ravines or gullies where surface water is concentrated and easily percolates through the wastes. Seepage from these areas is often polluted and may be toxic. The most extensive dump area is the railroad yard at Crestline, which is mainly cinder material and coal waste. Other areas are city and township dumps, which are now inactive. The county sanitary landfill in Whetstone Township is also a part of this unit.

Dumps are unsuited to crops. They are poorly suited to woodland, wildlife, or outdoor recreational use. The refuse fill is poorly compacted in most dumps and is not stable enough for foundations of buildings.

Environmental hazards can be reduced by diverting surface and seepage water. The surface can be blanketed with a slowly permeable layer to seal out percolating rainfall, and topsoil can be added to help support a ground cover of trees or grasses. If land use is carefully planned, most areas can be made suitable for openland uses. Capability subclass and woodland suitability subclass not assigned.

EtA—Elliott silt loam, 0 to 3 percent slopes. This nearly level, somewhat poorly drained soil is on ground moraines and end moraines at slightly elevated positions above the more extensive Pewamo and Luray soils. It formed mainly in glacial till, but in some places it partly formed in a relatively thin silt mantle.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsurface layer, to a depth of about 15 inches, is very dark grayish brown silty clay loam. The subsoil is mottled, brown and olive brown silty clay loam and clay loam. The substratum between depths of about 36 and 68 inches is mottled, olive brown clay loam glacial till.

Included with this soil in mapping are small areas of Pewamo and Luray soils in depressions and Blount and Bennington soils on low knolls. A few areas of soils are silty in the upper part of the solum, similar to the Tiro soils. This mantle of silt varies in thickness within short distances and most often occurs where this Elliott soil is near Luray and Tiro soils. In a few places, the depth of silt exceeds 4 feet.

This soil has moderately slow permeability in the subsoil. A perched water table is in the upper part of the subsoil late in winter and spring, or during prolonged rainy periods. The available water capacity is high, and most crops generally have sufficient moisture during the growing season. The root zone is moderately deep when this soil is drained. Reaction is medium acid to mildly alkaline. Because of the high content of organic matter in the surface layer, crusting and sealing are not a concern.

Most areas of this soil are used for cropland. A small acreage is in pasture. This soil has good potential for most crops and for some engineering uses if it is drained.

This soil has a moderate hazard of wetness for cropland. Subsurface drainage is effective in removing excess water. Productivity is high where this soil is drained. The surface layer has good tilth and is well suited to seed germination and plant growth. Since this soil is intermingled with Pewamo or Luray soils in most fields, management commonly follows the needs of these more dominant soils.

This soil has severe limitations for residential development. Surface water management and foundation drainage are needed around most structures. Seasonal wetness and restricted permeability limit this soil for use as septic tank absorption fields.

Wildlife habitat and outdoor recreation uses are affected in various ways by the seasonal high water table. Wetness limits the kinds and growth characteristics of native plant species. It enhances wetland wildlife, but reduces the habitat for upland wildlife. The seasonal high water table also limits the use for camping and hunting. Capability subclass IIw; woodland suitability subclass 2w.

FcA—Fitchville silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is mainly on flats or slight knolls. It formed in lacustrine deposits that are high in silt content.

Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The subsoil extends to a depth of about 54 inches. It is mottled, yellowish brown, grayish brown, and light brownish gray silty clay loam. The substratum between depths of about 54 and 78 inches is mottled, yellowish brown and brown clay loam.

Included with this soil in mapping are spots of Luray and Sebring soils; some areas of soil that have glacial till at a depth of 3 to 6 feet; and a few areas of soil that have a sandy or gravelly layer below a depth of 3 feet.

This soil has moderately slow permeability. Available water capacity is high. Runoff is slow. This soil has a high water table during winter and spring. The root zone is deep. Reaction in the root zone is medium acid to very strongly acid in the upper part and slightly acid or neutral in the lower part, unless the soil has been limed. Content of organic matter in the surface layer is moderate.

Most areas of this soil are used for cropland. A small acreage is in pasture and woodland. The potential is good for cultivated crops and for some engineering uses if this soil is drained. Crops respond well where appropriate drainage and fertility practices are applied. Surface and subsurface drainage is effective in removing excess water.

This soil is subject to compaction when heavy machinery is used. Crusting and sealing of the surface layer after rain result in reduced infiltration. Management practices to maintain tilth include minimum tillage and tillage at the proper moisture condition. Also, legumes and grasses on this soil aid in maintaining good tilth.

This soil has severe limitations for residential development. Surface water management and foundation drainage are needed around most structures. Seasonal wetness and restricted permeability limit this soil for use as septic tank absorption fields.

Woodland, wildlife habitat, and outdoor recreation uses are affected in various ways by the seasonal high water table. Wetness limits the kinds and growth characteristics of native plant species, reduces desirability for upland wildlife habitat, and limits use for camping and hunting. Capability subclass IIw; woodland suitability subclass 2w.

FcB—Fitchville silt loam, 2 to 6 percent slopes. This gently sloping, somewhat poorly drained soil is on gentle rises and lower toe slopes near small natural drainageways. It formed in lacustrine deposits that are high in silt content.

Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The subsoil extends to a depth of about 50 inches. It is mottled, yellowish brown, grayish brown, and light brownish gray silty clay loam. The substratum between depths of about 50 and 70 inches is mottled, yellowish brown and brown clay loam.

Included with this soil in mapping are spots of Luray and Sebring soils in depressions and along drainageways; some areas of soils that have glacial till within a depth of 3 to 6 feet; and a few areas of soils that have a sandy or gravelly layer below a depth of 3 feet. Also included are areas that have a surface layer of fine sandy loam.

This soil has moderately slow permeability. Available water capacity is high. Runoff is medium. This soil has a high water table during winter and spring. The root zone is deep. Reaction in the root zone is medium acid to very strongly acid in the upper part and slightly acid or neutral in the lower part, unless the soil has been limed. Content of organic matter in the surface layer is moderate.

Most areas of this soil are used for cropland. A small acreage is in pasture and woodland. The potential is good for cultivated crops and for some engineering uses if this soil is drained. Crops respond well when appropriate drainage and fertility practices are applied. Surface and subsurface drainage is effective in removing excess water.

Erosion is a moderate hazard on this soil, especially where slopes are relatively long. The surface layer is especially erodible when it is loose and unprotected from high-intensity rains. Losses of soil by erosion directly affect the long term productivity. Practices that include minimum tillage, sod waterways, and the use of meadow crops in the cropping system help control erosion. Systematic subsurface drainage is commonly used to remove excess water.

This soil is subject to compaction when heavy machinery is used. Crusting and sealing of the surface layer after rain result in reduced infiltration. Management practices to maintain tilth include minimum tillage and tillage at the proper moisture condition. Also, legumes and grasses on this soil aid in maintaining good tilth.

This soil has severe limitations for residential development. Surface water management and foundation drainage are needed around most structures. Seasonal wetness and restricted permeability limit this soil for use as septic tank absorption fields.

Woodland, wildlife, and outdoor recreation uses are affected in various ways by the seasonal high water table. Wetness limits the kind and growth characteristics of native plant species, reduces desirability for upland wildlife habitat, and limits use for camping and hunting. Capability subclass IIe; woodland suitability subclass 2w.

GaA—Gallman silt loam, 0 to 2 percent slopes. This nearly level, well drained soil is on high level terraces and outwash deltas. It formed in poorly sorted glacial material. Areas of this soil are large and have relatively uniform slopes.

Typically, the surface layer is dark brown silt loam 11 inches thick. The subsoil is about 63 inches thick and is mostly yellowish brown. It has mottles below a depth of 30 inches. It is silt loam in the upper part; clay loam in the middle part; and gravelly sandy clay loam, gravelly loam, and clay loam in the lower part. The substratum to a depth of about 80 inches is light olive brown loam.

Included with this soil in mapping are areas of Fitchville, Chili, and Bogart soils.

This soil has moderately rapid permeability. Available water capacity is moderate. Runoff is slow. The root zone is deep. Reaction in the root zone is mostly slightly acid or medium acid below the surface layer. Content of organic matter in the surface layer is moderately low. The gravelly clay loam and gravelly sandy clay loam layers at depths of 3 to 5 feet provide good internal drainage. Water moves readily through these layers.

Most of this soil is used for cropland. A small acreage is in pasture and woodland. Alfalfa, corn, potatoes, and tomatoes produce well on this soil. This soil is also well suited to irrigation when supplemental water is needed. Since this soil has only slight or moderate limitations for a variety of uses, strong competition among different land uses is common.

The surface layer is subject to crusting after heavy rains where this soil is cultivated. This reduces infiltration of water and tends to increase runoff. Meadow crops in the rotation help maintain tilth.

The presence of distinct gray mottles below a depth of 2 1/2 feet in some areas indicates a period of saturation for layers below this depth. The saturation commonly does not limit root development or tillage operation. It can cause seepage along deep foundation walls. Generally good engineering properties make this soil attractive for building sites, road location, and onsite sewage effluent absorption fields. Capability class I; woodland suitability subclass 1o.

GaB—Gallman silt loam, 2 to 6 percent slopes. This gently sloping, well drained soil is on high level terraces and outwash deltas. It formed in poorly sorted glacial material. Areas of this soil are large and have relatively uniform slopes.

Typically, the surface layer is dark brown silt loam 11 inches thick. The subsoil is about 63 inches thick and is mostly yellowish brown. It has mottles below a depth of 30 inches. It is silt loam in the upper part; clay loam in the middle part; and gravelly sandy clay loam, gravelly loam, and clay loam in the lower part. The substratum to a depth of about 80 inches is light olive brown loam.

Included with this soil in mapping are areas of Fitchville, Chili, and Bogart soils.

This soil has moderately rapid permeability. Available water capacity is moderate. Runoff is medium. The root zone is deep. Reaction in the root zone is mostly slightly acid to medium acid below the surface layer. Content of organic matter in the surface layer is moderately low. The gravelly clay loam and gravelly sandy clay loam layers at depths of 3 to 5 feet provide good internal drainage. Water moves readily through these layers.

Most of this soil is used for cropland. A small acreage is in pasture and woodland. Alfalfa, corn, potatoes, and tomatoes produce well on this soil. This soil is also well suited to irrigation when supplemental water is needed. Since this soil has only slight or moderate limitations for a variety of uses, strong competition among different land uses is common.

Erosion is a moderate hazard when this soil is farmed. The surface layer is subject to crusting after heavy rain where it is cultivated.

Good management practices include application of lime and fertilizer, control of runoff, and addition of plant residue. Cultural practices that reduce erosion are those that shorten the length of slope, increase infiltration, and maintain vegetative or residue cover. Sod waterways are needed where runoff collects in concentrated flow. Rotations that include meadow crops and minimum tillage help maintain tilth and control erosion.

Generally, good engineering properties make this soil attractive for building sites, road location, and onsite sewage effluent absorption fields. Some seepage water can occur below a depth of 2 1/2 feet. Capability subclass IIe; woodland suitability subclass 1o.

GwB—Glynwood silt loam, 2 to 6 percent slopes. This gently sloping, moderately well drained soil is on low knolls and ridges common to end moraines. It formed in calcareous glacial till.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil is about 25 inches thick. It is yellowish brown silty clay loam in the upper part and mottled dark yellowish brown and brown silty clay and clay loam in the lower part. The substratum to a depth of about 60 inches is mottled brown clay loam. A few pebbles and stones are throughout the soil.

Included with this soil in mapping are areas that contain less clay in the subsoil. These areas are mainly where this soil is near Alexandria and Marengo soils.

This soil has slow permeability. Available water capacity is moderate. Runoff is medium. A perched water table is in the subsoil in winter and spring. Natural drainage is generally adequate for crop production, although there are brief periods of saturation during the growing season. The root zone is moderately deep to glacial till. Reaction in the root zone is very strongly acid to neutral. Content of organic matter in the surface layer is moderately low.

Most areas of this soil are used as cropland. Corn, soybeans, small grain, and hay are the principal crops. Some areas are in native hardwood forest. This soil has good potential as cropland. It has some limitations for urban development, but most of these can be overcome by careful site planning. Glynwood soils are poorly suited to sewage effluent absorption because of restricted permeability in the subsoil.

High productivity of crops requires liming to correct acidity and adding plant nutrients. This soil has a moderate hazard of erosion. Where cultivated, it is subject to crusting after heavy rains. Cultural measures that reduce erosion are those that shorten the length of slope, increase infiltration, and prevent raindrop impact on bare soils. Where runoff collects in concentrated flow, well sodded waterways are needed. Plant residue, manure, and minimum tillage aid in maintaining or improving soil structure in the surface layer.

Woodland productivity is good. Where new tree plantings are made, competition from grasses and shrubs is a concern.

This soil has more desirable residential uses than most nearby soils. Site planning for dwellings needs to include stockpiling surface soil for final grading and to include foundation drains to intercept seepage water and lower the seasonal water table. It should also include measures to control runoff during construction to prevent sedimentation of storm sewers and streams, grading to remove surface water, and timely seeding establishment soon after construction is completed. Peak runoff levels can be lowered during construction by using sediment basins. This soil provides fair to good roadfill and material for reservoir embankments. Wetness can limit excavation during winter and spring. Capability subclass IIe; woodland suitability subclass 2o.

GwB2—Glynwood silt loam, 2 to 6 percent slopes, moderately eroded. This gently sloping, moderately well drained soil is on low knolls and ridges common to end moraines. It formed in calcareous glacial till. Most areas are at the head of small drainageways.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil is about 25 inches thick. The upper part of the subsoil is yellowish brown silty clay loam, and the lower part is mottled, dark yellowish brown and brown silty clay and clay loam. The substratum to a depth of about 60 inches is mottled, brown clay loam. A few pebbles and stones are throughout the soil.

Included with this soil in mapping are small areas of Blount and Tiro soils and a few spots of Alexandria and Chili soils. Also included are hummocky areas of soils that contain less clay and have a more variable subsoil than this soil.

This soil has slow permeability. Available water capacity is moderate. Runoff is medium. A perched water table is in the subsoil in winter and spring. Natural drainage is generally adequate for crop prouction, although there are brief periods of saturation during the growing season. The root zone is moderately deep to glacial till. Reaction in the root zone is very strongly acid to neutral. Content of organic matter in the surface layer is moderately low.

Most areas of this soil are used as cropland. Corn, soybeans, small grain, and hay are the principal crops. Some areas are in native hardwood forest. This soil has good potential as cropland. Past erosion has somewhat reduced the quality of the surface layer, but proper liming, fertilization, and management can restore much of its original productivity. This soil has some limitations for urban development, but most of these can be overcome by careful site planning. This soil is poorly suited to sewage effluent absorption, because of restricted permeability in the subsoil.

The hazard of erosion is severe if the soil is cultivated. Erosion has reduced the thickness of the surface layer, and plowing has resulted in mixing material from the subsoil with material from the surface layer. Tilth and available water capacity have been reduced. If cultivated, this soil is highly susceptible to crusting after rain. Cultural measures that reduce erosion are those that shorten the length of slope, increase infiltration, and prevent raindrop impact on bare soils. Where runoff collects in concentrated flow, well sodded waterways are needed. Plant residue, manure, and minimum tillage aid in maintaining or improving tilth.

Woodland productivity is good. Where new tree plantings are made, competition from grasses and shrubs is a concern.

This soil has more desirable residential uses than most nearby soils. Site planning for dwellings needs to include stockpiling surface soil for final grading and to include foundation drains to intercept seepage water and lower the seasonal high water table. Site planning should also include measures to control runoff during construction to prevent sedimentation of storm sewers and streams, grading to remove surface water, and timely seeding establishment soon after construction is completed. Peak runoff levels can be lowered during construction by using sediment basins. This soil provides fair to good roadfill and material for reservoir embankments. Wetness can limit excavation during winter and spring. Capability subclass IIIe; woodland suitability subclass 2o.

GwC2—Glynwood silt loam, 6 to 12 percent slopes, moderately eroded. This sloping, moderately well drained soil is along small streams and on hummocky end moraines. It formed in calcareous glacial till. Slopes are short.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil is about 25 inches thick. The upper part of the subsoil is yellowish brown silty clay loam, and the lower part is mottled, dark yellowish brown and brown silty clay and clay loam. The substratum to a depth of about 60 inches is mottled brown clay loam. A few pebbles and stones are throughout the soil.

Included with this soil in mapping are small areas of Blount and Tiro soils and hummocky areas of Alexandria and Lykens soils.

This soil has slow permeability. Available water capacity is moderate. Runoff is rapid. A perched water table is in the subsoil in winter and spring. Natural drainage is generally adequate for crop production, although there are brief periods of saturation during the growing season. The root zone is moderately deep to glacial till. Reaction in the root zone is very strongly acid to neutral. Content of organic matter in the surface layer is moderately low.

Most areas of this soil are used as cropland. Corn, soybeans, small grain, and hay are the principal crops. Some areas are in native hardwood forest. This soil has good potential as cropland. Past erosion has somewhat reduced the quality of the surface layer, but proper liming, fertilization, and management can restore much of the original fertility. This soil has some limitations for urban development, but most of these can be overcome by careful site planning. This soil is poorly suited to sewage effluent absorption, because of restricted permeability in the subsoil.

The hazard of erosion is severe if this soil is cultivated. Erosion has reduced the thickness of the surface layer, and plowing has mixed material from the subsoil with material from the surface layer. Tilth and available water capacity have been reduced. If cultivated, this soil is highly susceptible to crusting after rain. High productivity of crops requires liming to correct acidity and adding plant nutrients. Cultural measures that reduce erosion are those that shorten the length of slopes, increase infiltration, and prevent raindrop impact on bare soils. Where runoff collects in concentrated flow, well sodded waterways are needed. Plant residue, manure, and minimum tillage aid in maintaining or improving soil structure in the surface layer.

Woodland productivity is good. Where new tree plantings are made, competition from grasses and shrubs is a concern.

This soil has more desirable residential uses than most nearby soils. Site planning for dwellings needs to include stockpiling surface soil for final grading and to include foundation drains to intercept seepage water and lower the seasonal high water table. Site planning should also include measures to control runoff during construction to prevent sedimentation of storm sewers and streams, grading to remove surface water, and timely seeding establishment soon after construction is completed. Peak runoff levels can be lowered during construction by using sediment basins. This soil provides fair to good roadfill and material for reservoir embankments. Wetness can limit excavation during winter and spring. Capability subclass IIIe; woodland suitability subclass 2o.

GwD2—Glynwood silt loam, 12 to 18 percent slopes, moderately eroded. This moderately steep, moderately well drained soil is along major stream valleys and on the more irregular, hummocky parts of end moraines. This soil formed in calcareous glacial till.

Typically, the surface layer is brown silt loam about 6 inches thick. The subsoil is about 24 inches thick. The upper part of the subsoil is yellowish brown silty clay loam, and the lower part is dark yellowish brown and brown silty clay and clay loam. A few pebbles and stones are throughout the soil.

Included with this soil in mapping are a few spots that have been severely eroded by sheet and rill erosion and many wooded areas that are slightly eroded.

This soil has slow permeability. Available water capacity is moderate. Runoff is rapid. A perched water table is in the subsoil in winter and spring. Natural drainage is generally adequate for crop production, although there are brief periods of saturation during the growing season. The root zone is moderately deep to glacial till. Reaction in the root zone is very strongly acid to neutral. Content of organic matter in the surface layer is moderately low.

Most areas of this soil are used for pasture, wildlife, or woodland. Some areas are used for cropland. This soil has poor potential for cropland and fair to poor potential for most engineering uses.

The hazard of erosion is the main limitation for farming. Droughtiness is also a limitation during dry seasons. Management practices to control erosion and conserve moisture are needed on this soil. The best potential for this soil is for forage crops or improved pasture for livestock.

Moderately steep slopes are a major limitation for most engineering uses. Some small pond sites, however, are on this soil. The soil has moderately high productivity for timber and is well suited to upland game habitat. The landscape is varied in relief and provides scenery and recreational uses. Capability subclass IVe; woodland suitability subclass 2r.

HpE—Hennepin-Alexandria silt loams, 18 to 50 percent slopes. These soils are steep and very steep and well drained. They formed in glacial till. They are on side slopes along deeply dissected stream valleys. The total relief of most areas is about 30 to 50 feet. Most areas are about 50 percent Hennepin soils and 50 percent Alexandria soils. Alexandria soils are more extensive where slopes are less than 40 percent, and Hennepin soils are predominantly in the steeper parts of most areas. Hennepin and Alexandria soils are in an intricate pattern, and it was not practical to map them separately.

Typically, the Hennepin soils have a dark grayish brown silt loam surface layer about 3 inches thick. The subsoil is brown clay loam. The underlying material between depths of 14 and 60 inches is brown clay loam glacial till.

Typically, the Alexandria soils have a dark brown silt loam surface layer about 6 inches thick. The subsoil is brown clay loam. The substratum between depths of 30 and 60 inches is dark brown clay loam glacial till.

Included with these soils in mapping are narrow areas of Shoals soils along streams that transect most areas; occasional outcrops of limestone, shale, and sandstone on the lower part of slopes; and small areas of soils that have a loam surface layer.

The Hennepin soils have moderately slow permeability and low available water capacity. The root zone is shallow. Alexandria soils have moderate permeability and moderate available water capacity. The root zone is moderately deep. Both of these soils have moderately low content of organic matter in their surface layer. Runoff is very rapid.

These soils are seldom cultivated. They are mainly in woodland or pasture. Because of the steep and very steep slopes, the potential for cropland and for most engineering uses is poor. These soils have good potential and are well suited to woodland. They are suited to some recreational uses. A severe erosion hazard and steepness of slope are the major limitations. These soils are generally stable, but slippage can occur near seep spots.

These soils are not well suited to residential development or most other engineering uses. However, they do have scenic value because of their diversity of slopes and proximity to streams. Capability subclass VIIe; woodland suitability subclass 2r.

JtA—Jimtown loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on glacial outwash plains and melt water channels. It formed in assorted layers of loamy, sandy, and gravelly material that was deposited by water.

Typically, the surface layer is dark grayish brown loam about 9 inches thick. The subsoil is about 33 inches thick. The upper part of the subsoil is mottled, dark brown loam, and the lower part is mottled, dark yellowish brown and brown sandy loam. The substratum to a depth of 84 inches is mottled, yellowish brown, gray, and black stratified loam, sandy loam, and gravelly sandy loam.

Included with this soil in mapping are small areas of Olmsted, Colwood, and Marengo soils in swales or depressions and small areas of Bennington, Blount, Bogart, and Chili soils that are at a higher elevation and contribute runoff and seepage to this Jimtown soil. Also included near Bennington soils are areas where the substratum commonly consists of clay loam glacial till rather than stratified gravelly and sandy material.

This soil has moderate permeability. Available water capacity is moderate. Runoff is slow. The root zone is deep. Reaction is very strongly acid to moderately alkaline below the surface layer. Content of organic matter is moderate. Tilth is generally good, because of the loamy surface layer.

This soil is used mostly for cropland. The principal crops are corn, soybeans, small grain, and hay. Wetness is a moderate limitation for crops. Artificial drainage is effective in increasing most crop production.

Wetness is a hazard for residential development. Drainage improves the strength and workability of this soil. Surface water management and foundation drainage are needed around most structures. Seasonal wetness also limits this soil for use as septic tank absorption fields. Capability subclass IIw; woodland suitability subclass 2w.

JtB—Jimtown loam, 2 to 6 percent slopes. This gently sloping, somewhat poorly drained soil is on knolls and ridges on outwash plains and melt water channels. It formed in assorted layers of loamy, sandy, and gravelly material deposited by water.

Typically, the surface layer is dark grayish brown loam about 9 inches thick. The subsoil is about 33 inches thick. The upper part of the subsoil is mottled, brown or dark brown loam or sandy loam, and the lower part is mottled, dark yellowish brown sandy loam. The substratum to a depth of 84 inches is stratified loam, sandy loam, and gravelly sandy loam.

Included with this soil in mapping are many small areas of soils that have a silt loam surface layer, a few spots that have a gravelly loam surface layer, some areas that have no gravel to a depth of 2 or 3 feet, and a few areas that are underlain by clay loam glacial till at a depth of 3 to 5 feet. Also included are some areas of poorly drained, dark colored soils in depressions and minor drainageways and small areas of moderately well drained Bogart soils on the tops of the higher knolls and ridges.

This soil has moderate permeability. Available water capacity is moderate. Runoff is medium. The root zone is deep. Reaction in the root zone is very strongly acid to moderately alkaline. Artificial drainage is effective in increasing crop production. Content of organic matter is moderate. Tilth is generally good because of the loamy surface layer.

This soil is used mostly for cropland. The principal crops are corn, soybeans, small grain, and hay.

The hazard of erosion is moderate where this soil is cultivated. Wetness is a limitation. Cropping systems using minimum tillage are effective in controlling erosion.

Wetness is a hazard for residential development. Drainage improves the strength and workability of this soil. Surface water management and drainage around foundations are needed. Seasonal wetness limits this soil for use as septic tank absorption fields. Capability subclass IIe; woodland suitability subclass 2w.

KbA—Kibbie fine sandy loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is along the margins of former glacial lake basins. It formed in stratified loamy to clayey glacial lake sediment. Most areas are slightly elevated and surrounded by wetter soils.

Typically, the surface layer is dark grayish brown fine sandy loam about 10 inches thick. The subsoil between depths of about 10 and 45 inches is mottled, brown silt loam, grayish brown fine sandy loam, and yellowish brown silt loam. The substratum to a depth of about 61 inches is mottled, brown loam and yellowish brown sandy loam.

Included with this soil in mapping are areas of soils that have glacial till at a depth of 3 to 6 feet; some spots of Jimtown and Wilmer soils; and some areas of this soil, especially in the upper part of Brokensword Creek Valley, that contain more sand and less clay than is common. Also included along stream channels are a few areas of soil that are subject to occasional flooding.

This soil has moderate permeability. Available water capacity is moderate. A perched water table is in the subsoil during winter and early in spring. Content of organic matter in the surface layer is moderate. The root zone is deep. Reaction in the root zone is medium acid to neutral below the surface layer.

Most areas of this soil are used for cropland. A relatively small acreage is in pasture or woodland. If adequately drained, this soil is suited to irrigation and to most specialty crops common to the area. This soil has good potential for cropland but fair to poor potential for most engineering uses.

Wetness is a moderate hazard when this soil is used for farming. Surface and subsurface drainage is effective in lowering the water table. Outlets for drainage commonly need to be developed or improved in many areas. Ditchbanks are unstable in this soil, and surface drains need to be located in such a manner that deep cuts will not develop. The surface layer has good infiltration and good tilth. Some areas are subject to surface crusting after heavy rain. Legumes and grasses on this soil aid in maintaining good tilth.

This soil has low strength when it is saturated. It becomes very soft when wet, and it is difficult to operate machinery under wet conditions. Excavation slopes are unstable when the water table is high.

This soil has a wetness hazard for residential development. Drainage is the most effective means of improving strength and workability of this soil. Storm and foundation drains are essential for residential development where basements are installed. Because of the seasonal high water table, this soil is poorly suited to septic tank absorption fields. The seasonal high water table also affects the type of woodland, the kind of wildlife habitat, and the outdoor recreation uses that are best suited to this soil. Capability subclass IIw; woodland suitability subclass 2w.

KcB—Kibbie-Bennington complex, 2 to 6 percent slopes. These soils are gently sloping and somewhat poorly drained. Kibbie soils formed in loamy glacial lake sediment, and Bennington soils formed in glacial till. The soils are either on ridges on lake plains or on toe slopes on deltas or terraces along the larger valleys. Most areas are about 50 percent Kibbie soils and 40 percent Bennington soils. Other included soils occupy the remaining 10 percent. The Kibbie and Bennington soils are in such an intricate pattern that it was not practical to map them separately.

Typically, the Kibbie soils have a dark grayish brown fine sandy loam surface layer about 10 inches thick. The subsoil between depths of about 10 and 45 inches is mottled, brown silt loam, grayish brown fine sandy loam, and yellowish brown silt loam. The substratum to a depth of 61 inches is mottled, brown loam and yellowish brown sandy loam.

Typically, the Bennington soils have a dark grayish brown loam surface layer about 8 inches thick. The subsoil between depths of about 8 and 30 inches is mottled, yellowish brown silty clay loam and silty clay. The substratum to a depth of about 60 inches is mottled, dark brown clay loam glacial till.

Included with these soils in mapping are small areas of Tuscola soils along ridge crests.

The Kibbie soils have moderate permeability and moderate available water capacity. The root zone is deep. Reaction in the root zone is medium acid to neutral. The Bennington soils have moderately slow or slow permeability and moderate available water capacity. The root zone is moderately deep to glacial till. Reaction in the root zone is very strongly acid to slightly acid in the upper part, unless the soil has been limed, but becomes less acid as depth increases. Kibbie and Bennington soils have a seasonal high water table during winter and spring. They have moderate organic-matter content in their surface layers.

Most areas of this map unit are used for growing the principal field crops in the county. Corn, soybeans, small grain, and hay are the main crops. A relatively small acreage is in pasture or woodland. These soils have good potential for cultivated crops but fair to poor potential for most engineering uses.

Erosion is a moderate hazard when these soils are farmed, especially where slopes are long or where runoff is concentrated. Practices that shorten the length of slope, provide for the use of sod waterways, and allow a minimum of tillage are effective in controlling erosion.

Both Kibbie and Bennington soils have moderate limitations for farming because of seasonal wetness. Surface and subsurface drains are effective in lowering the water table. Outlets for drainage commonly need to be developed or improved in many areas. Ditchbanks are unstable in the Kibbie soils, and surface drains need to be located where deep cuts are not necessary. The Kibbie soils have good infiltration and good tilth. The Bennington soils are subject to crusting after heavy rain. Crusting lowers infiltration and increases runoff and the hazard of erosion. Legumes and grasses in the cropping system help to improve tilth.

Wetness is a hazard for residential development. Drainage improves the strength and workability of both soils. Adequate surface water management and foundation drainage are needed around most structures. Restricted permeability of the Bennington soils and the seasonal high water table of both Kibbie and Bennington soils limit the use of these soils for septic tank absorption fields. The Kibbie soils have low strength when saturated. They become very soft when wet, and it is difficult to operate machinery under wet conditions. Excavation slopes are unstable when the water table is high.

Woodland, wildlife habitat, and outdoor recreation uses are affected by the seasonal high water table in these soils. This limits the selection and growth of native plants and restricts the habitat for some animals. Seasonal wetness limits such outdoor activities as camping or hunting. Capability subclass IIe; woodland suitability subclass 2w.

Le—Lenawee silty clay loam. This nearly level, very poorly drained soil formed in stratified silt and clay sediment of former glacial lakes.

Typically, the surface layer is black silty clay loam about 9 inches thick. The subsoil is about 36 inches thick. The upper part of the subsoil is mottled, dark gray or gray silty clay loam and silty clay, and the lower part is yellowish brown and olive gray silty clay loam. The substratum to a depth of about 60 inches is mottled, dark gray silty clay loam.

Included with this soil in mapping are small areas of very poorly drained Luray soils and poorly drained Sebring soils, some small areas of soils that are in the lower part of depressions and are subject to ponding, and some areas of Bono soils in low spots. Also included are a few areas of this Lenawee soil that has a silty clay surface layer and subsoil. The included areas are more difficult to drain and manage.

This soil has moderately slow permeability. Available water capacity is high. Runoff is very slow. Content of organic matter in the surface layer is high. The root zone is deep if this soil is drained. Reaction in the root zone is medium acid or slightly acid below the surface layer. It grades to neutral and mildly alkaline as depth increases.

This soil is used mainly for field crops commonly grown in the county. Corn, soybeans (fig. 3), small grain, and hay are the main crops. A relatively small acreage is in pasture or woodland. Native vegetation consists of those species tolerant of wetness. If adequately drained, this soil is suited to specialty crops and to irrigation. It has fair to poor potential for most engineering uses.

Wetness is a moderate limitation where this soil is used for farming. Unless the surface water is removed and the water table lowered, the growing season for this soil is shortened by delayed planting in spring. In most years this soil commonly remains wet into June. Even in dry years, the shallow water table limits depth of root development, and by late in summer, many plants show moisture stress. Harvesting operations are also hampered by poor drainage. Erosion is a hazard where this soil is in drainageways. Grassed waterways should be used.

This soil has high capacity to store and release nutrients for plant growth. It is subject to compaction when heavy machinery is used. Crusting and sealing of the surface layer after rain result in reduced infiltration. Management practices to maintain tilth include tillage at the proper moisture condition and good use of available crop residue. Deep-rooted legumes and grasses on this soil also aid in maintaining good tilth.

Plantings for pasture and woodland should include species that tolerate wetness. During wet periods, the use of equipment is limited.

This soil has low strength, especially when it is saturated. The most effective means of improving soil strength is by removing excess water. Drainage also reduces damage caused by frost action. Moderately slow permeability and a seasonal high water table make this soil poorly suited to sewage effluent disposal by standard design systems. The shrink-swell potential of the more plastic layers can cause damage to pavements and walls. Extra thickness or reinforcement of foundations is needed to prevent cracking of structures. Capability subclass IIw; woodland suitability subclass 2w.

Lg—Lenawee silt loam, overwash. This nearly level, poorly drained soil formed in alluvial and lacustrine sediment. Recent, frequent stream overflow has deposited 10 to 24 inches of sediment on this Lenawee soil.

Typically, the surface layer is dark grayish brown silt loam about 12 inches thick. The subsurface layer is about 8 inches of dark gray silty clay loam. The subsoil is grayish brown silty clay loam. The substratum between depths of about 36 and 60 inches is stratified silt loam, loam, and silty clay loam.

Included with this soil in mapping are small areas of the poorly drained Sebring soils and some areas of soil that has a buried layer of very dark silty clay below the silt loam surface layer.

This soil has moderately slow permeability. Available water capacity is high. Runoff is very slow. Content of organic matter in the surface layer is moderate. The root zone is deep when the soil is drained. Reaction in the root zone is medium acid or slightly acid below the surface layer. It grades to neutral and mildly alkaline as depth increases.

This soil is used mainly for field crops commonly grown in the county. Corn, soybeans, small grain, and hay are the main crops. A relatively small acreage of this soil is in pasture or woodland. Native vegetation consists of those species that tolerate wetness. If adequately drained, this soil is suited to specialty crops and to irrigation. It has fair to poor potential for most engineering uses.

Wetness is a moderate limitation when this soil is used for farming. Unless the surface water is removed from this soil and the water table is lowered, the growing season is shortened by delayed planting in spring. In most years this soil commonly remains wet into June. Even in dry years, the shallow water table limits the depth of root development, and late in summer, many plants show moisture stress. Harvesting operations are also hampered by poor drainage. Erosion is a hazard where the soil is in drainageways. Sod waterways should be used.

This soil has high capacity to store and release nutrients for plant growth. It is subject to compaction when heavy machinery is used. Crusting and sealing of the surface layer after rain result in reduced infiltration. Management practices to maintain tilth include tillage at the proper moisture condition and good use of available residue. Deep-rooted legumes and grasses on this soil also aid in maintaining good tilth.

Planting for pasture and woodland should include species that tolerate wetness. During wet periods, the use of equipment is limited.

This soil has low strength, especially when it is saturated. The most effective means of improving soil strength is by removing excess water. Drainage also reduces damage caused by frost action. Moderately slow permeability, the flooding hazard, and the seasonal high water table make this soil poorly suited to sewage effluent disposal by standard design systems. The shrink-swell potential of the more plastic layers can cause damage to pavements and walls. Extra thickness or reinforcement of foundations is needed to prevent cracking of structures. Capability subclass IIIw; woodland suitability subclass 2w.

Lh—Lenawee Variant silty clay loam. This nearly level, very poorly drained soil formed in silt and clay glacial lake sediment. This soil originally had an organic surface layer, which was destroyed by oxidation or burning, or both, after the soil was drained and cultivated.

Typically, the surface layer is very dark grayish brown silty clay loam about 8 inches thick. The subsoil is about 33 inches thick. It is dark gray and gray silty clay in the upper part and grayish brown silty clay loam in the lower part. The substratum to a depth of about 80 inches is stratified brown, greenish gray, and dark greenish gray silty clay loam, silt loam, and fine sandy loam.

Included with this soil in mapping are areas of soils that have an organic surface layer as much as 14 inches thick; a few areas that have a residue of burned organic matter on the surface that appears as reddish brown ash; and some small areas, in the lower part of depressions, that are subject to ponding. Also included are a few small areas of Bono, Luray, Lenawee, and Sebring soils, mostly near the edge of the mapped areas.

This soil has moderately slow permeability. Available water capacity is high. The root zone is deep in drained areas. Reaction is very strongly acid to medium acid. Content of organic matter in the surface layer is high. Runoff is very slow, and water is ponded in some areas after prolonged rain. A seasonal water table is near the surface during most of the year. Surface and subsurface drains are effective in controlling water levels, but they function slowly. Outlets for drainage water are difficult to establish and maintain because this soil is in a low position on the landscape and because the subsoil and underlying material are unstable.

The seasonal high water table and the hazard of ponding in some areas are severe limitations for most engineering uses. Acidity makes this soil highly corrosive to concrete and most metals. Capability subclass IIIw; woodland suitability subclass 3w.

Lo—Lobdell silt loam. This nearly level, moderately well drained soil is on the flood plains (fig. 4) of the larger streams. It formed in alluvial sediment deposited by overflowing streams.

Typically, the surface layer is brown silt loam about 5 inches thick. The subsurface layer, to a depth of about 15 inches, is dark grayish brown silt loam. The subsoil extends to a depth of about 50 inches. It is mottled, dark brown and dark yellowish brown silt loam. The substratum to a depth of about 72 inches is dark brown stratified loam and silt loam.

Included with this soil in mapping are small areas of soils that have a loam or fine sandy loam surface layer;

some areas of soils that contain gravel below a depth of 40 inches; and spots of Shoals and Sloan soils in depressions and former stream meander channels. Also included are narrow strips of well drained soils that are similar to this soil but have no mottles in the subsoil.

This soil has moderate permeability. Available water capacity is high. Runoff is slow. The root zone is deep. Reaction in the root zone is strongly acid to neutral. Content of organic matter in the surface layer is moderate. This soil is subject to flooding. It has a high water table for short periods in winter and spring.

Most broad areas of this soil are used as cropland; areas in the more narrow valleys are in pasture or woodland. This soil is well suited to most crops, but flooding is a hazard, especially to winter wheat. Commonly grown crops are corn, soybeans, small grain, and hay. This soil is poorly suited to most engineering uses.

The hazard of flooding is the main limitation for farming. Some areas are too badly dissected by old stream channels to be farmed conveniently. Streambank erosion and gouging by floodwater are concerns. This soil is friable, but tends to form a crust after heavy rain. Moisture is adequate for plant growth in most years. Weed control is a special concern since seeds are washed in by floodwater. Crop residue also can float away by floodwater. Winter cover crops are beneficial in controlling loss of soil and residue. This soil is well suited to irrigation. Limitations for woodland and pasture are few. Timber and grass yields are high.

This soil is poorly suited to dwellings or small commercial buildings. Structures on this soil are subject to very severe damage caused by high water and sediment. Any construction partly blocks the natural floodway, thus increasing flood heights upstream. In addition, this soil is friable and has low strength for foundations.

This soil is well suited to such less intensive uses as paths and trails or openland and woodland wildlife. It is also a good source of topsoil. Capability subclass IIw; woodland suitability subclass 1o.

Lu—Luray silty clay loam. This nearly level, very poorly drained soil is on broad flats and in slight depressions that were former shallow glacial lakes. It formed in lacustrine sediment that has a high silt content.

Typically, the surface layer is very dark grayish brown silty clay loam about 10 inches thick. The subsoil is about 40 inches thick. The upper part of the subsoil is mottled, dark gray or grayish brown silty clay loam, and the lower part is mottled, gray silt loam. The substratum to a depth of about 95 inches is stratified silt loam and fine sandy loam.

Included with this soil in mapping are small areas of the poorly drained Sebring soils and the very poorly drained Bono, Lenawee, or Muskego soils in small depressions; some small areas of soils that are in the lower part of depressions are subject to ponding; and spots of Elliott soils in areas south of the Sandusky River and west of the Olentangy River. Also included are some areas of this Luray soil that are near Sloan soils, have accumulations of very dark grayish brown silt loam alluvium as much as 2 feet thick, and are subject to occasional stream overflow. Pewamo and Condit soils are in some areas where dense glacial till is below a depth of 40 inches.

This soil has moderately slow permeability. Available water capacity is high. Runoff is slow. The root zone is deep when the soil is drained. Reaction in the root zone is medium acid to moderately alkaline. Artificial drainage is effective in increasing most crop production. Content of organic matter is high, and tilth is good.

Most drained areas are used as cropland. Undrained areas are in woodland or pasture. Artificial drainage is mainly accomplished by using existing natural channels and installing subsurface drainage systems. Where drained, this soil is one of the most productive in the county. Vegetation on undrained woodlots and pasture is dominated by native species of trees, shrubs, grasses, and forbs that are water tolerant.

Wetness is a moderate limitation to use of this soil for crops. If surface water is not removed and the water table is not lowered, the growing season is shortened by delayed planting in spring. Also, there is a gradual depletion of available soil moisture for crops during the mid and late parts of the growing season. This stress is related to the relative shallowness of root development caused by excessive wetness during the early part of the growing season. This soil has a high capacity to store and release nutrients for plant growth.

This soil is subject to compaction when heavy machinery is used. Management practices to maintain tilth include tillage at the proper moisture content and good use of available residue. Also, deep-rooted legumes and grasses on this soil aid in maintaining good tilth.

Plantings for pasture and woodland should include species that tolerate wetness (fig. 5). During wet periods, the use of equipment is limited.

This soil has low strength, especially when it is saturated. The most effective means of improving soil strength is by removing excess water. Drainage also reduces damage caused by frost action. Moderately slow permeability and a seasonal high water table make this soil poorly suited to sewage effluent disposal by standard design system. The shrink-swell potential of the more plastic soil layers can cause damage to pavements and walls. Extra thickness or reinforcement of foundations is needed to prevent cracking of structures. Windbreaks (fig. 6) should be used to reduce wind velocity and snow drifting around rural buildings. Capability subclass IIw; woodland suitability subclass 2w.

Lw—Luray-Urban land complex. This map unit consists of nearly level, very poorly drained Luray soils and areas of Urban land on smooth to slight depressions. Most areas are in the residential sections of cities. They are about 50 percent Luray silty clay loam, and 35 percent Urban land. Other included soils occupy the remaining 15 percent. Most areas have straight boundaries or are rectangular in shape. The shape of areas is determined by street and building design. The Luray soils are at the rear of lots, on undeveloped lots, or other openland areas.

Typically, the Luray soils have a very dark grayish brown silty clay loam surface layer about 10 inches thick. The subsoil is about 40 inches thick. The upper part is mottled, dark gray or grayish brown silty clay loam, and the lower part is mottled gray silt loam. The substratum to a depth of about 95 inches is stratified silt loam and fine sandy loam.

The Urban land part of this unit is covered by streets, parking lots, buildings, and other structures that obscure or alter the soils so that identification is not feasible. Typically, Urban land has a surface of concrete, sand, or coarse limestone aggregate. Below this the soil material is neutral to moderately alkaline clay loam or silty clay loam. In some areas this soil is the original subsoil or substratum, and in other areas it is fill material from nearby soils.

Included with these soils in mapping are some deeply disturbed, filled, or truncated areas that are not covered by streets or buildings; a few areas that are in the lower part of depressions and are subject to ponding; and areas of Luray soils, near buildings and in low spots, that have as much as 2 feet of fill material over the original soil. Also included are spots of Pewamo, Condit, and Lenawee soils.

The Luray soils have a high water table and moderately slow permeability. The available water capacity and the content of organic matter in the surface layer are high. These soils have high frost action potential, moderate shrink-swell potential, and low strength for foundations.

Where the Luray soils are drained, they are well suited to lawns and landscaping. They are poorly suited to onsite sewage disposal. Natural drainage has been altered by storm and foundation drains and by extensive surface grading to remove runoff. Seepage, frost heaving, shrink-swell, and soil wetness, however, are still concerns for many uses during winter, spring, and prolonged rainy periods.

Disturbed areas have poor conditions for plant growth. Although natural lime is commonly abundant, fertility and available water capacity are low. The root zone is shallow and is commonly very firm and compacted. These areas have good strength when properly compacted. Areas that have been covered by 2 to 10 feet of fill, however, are commonly only partly leveled and are seldom compacted to uniform density. Blanketing disturbed areas with topsoil helps establish ground cover. Mulch and proper fertilizer aid in establishing seedings. Capability subclass: Luray soils in IIw, Urban land, not assigned; woodland suitability subclass: Luray soils in 2w, Urban land, not assigned.

LzB—Lykens silt loam, 2 to 6 percent slopes. This gently sloping, moderately well drained soil is mainly on the highest part of relatively smooth landscapes. It formed in glacial lake sediment and the underlying glacial till. The lake deposits are mainly silt, but layers of fine sand are near the contact with glacial till.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil is about 31 inches thick. In sequence from the top, the upper 14 inches of the subsoil is yellowish brown silt loam and clay loam and has mottles below a depth of 17 inches; the next 7 inches is mottled, brown clay loam; and the lower 10 inches is mottled, dark yellowish brown silty clay loam. The substratum to a depth of about 75 inches is mottled, dark yellowish brown clay loam glacial till.

Included with this soil in mapping are small areas of Cardington, Glynwood, Fitchville, and Tuscola soils. These inclusions make up as much as 20 percent of some areas.

This soil has moderately slow or slow permeability. Available water capacity is moderate. A perched water table is present during winter and early in spring. The root zone is deep. Reaction is very strongly acid to medium acid, unless the soil has been limed. Content of organic matter in the surface layer is moderate. Runoff is medium.

Most areas of this soil are used for cropland. This soil has good potential for cropland and fair to good potential for most engineering uses.

Erosion is a moderate hazard when this soil is used for cropland. Minimum tillage, meadow crops in the rotation, and sod waterways are commonly used to control erosion. Artificial drainage of wet spots is needed in some areas. This soil is also subject to surface crusting after heavy rain.

The layers in the upper part of this soil that formed in water-deposited sediment have lower strength than those that formed in the underlying glacial till. This should be considered when designing ditches, small buildings, and roads. Because of slow permeability, this soil is poorly suited to septic tank absorption fields. It is well suited to most woodland, wildlife habitat, and recreational uses. Capability subclass IIe; woodland suitability subclass 2o.

Mb—Marengo silty clay loam. This nearly level, very poorly drained soil is in shallow, local depressions and in swales along natural watercourses. Most areas are small and this soil is intermingled with the better drained Bennington, Cardington, and Alexandria soils.

Typically, the surface layer is very dark grayish brown and very dark gray silty clay loam about 13 inches thick. The subsoil is about 40 inches thick. The upper part of the subsoil is mottled, dark grayish brown and grayish brown silty clay loam; and the lower part is mottled, light brownish gray and yellowish brown clay loam. The substratum to a depth of about 80 inches is olive brown clay loam and loam glacial till.

Included with this soil in mapping, on slight knolls, are spots of Cardington and Alexandria soils. Also included are small areas of Olmsted soils and, in the lower part of depressions, some small areas of soil that are subject to ponding.

This soil has moderate permeabililty. Available water capacity is high. This soil receives runoff and seepage from nearby soils. The root zone is deep when the soil is drained. Reaction is slightly acid or medium acid. Content of organic matter in the surface layer is high. Drainage is effective in lowering the water table.

This soil is used mainly for field crops commonly grown in the county. Corn, soybeans, small grain, and hay are the main crops. A relatively small acreage is in pasture or woodland. Native vegetation included those species that tolerate wetness. If adequately drained, this soil is suited to specialty crops and to irrigation. It has fair potential for most engineering uses.

Wetness is a moderate limitation where this soil is used for farming. If surface water is not removed and the water table is not lowered, the growing season is shortened by delayed planting in spring. This soil commonly remains wet into June. Harvesting operations are also hampered by poor drainage.

This soil has a high capacity to store and release nutrients for plant growth. It is subject to compaction when heavy machinery is used. Management practices to maintain tilth include tillage at the proper moisture condition and good use of available residue. Deep-rooted legumes and grasses on this soil also aid in maintaining good tilth.

Plantings for pasture and woodland should include species that tolerate wetness. During wet periods, the use of equipment is limited.

This soil has moderate to low strength, especially when it is saturated. The most effective means of improving soil strength is by removing excess water. Drainage also reduces damage caused by frost action. A seasonal high water table makes this soil poorly suited to sewage effluent disposal by standard design systems. The shrink-swell potential of the more plastic layers can cause damage to pavements and walls. Extra thickness or reinforcement of foundations is needed to prevent cracking of structures. Capability subclass IIw; woodland suitability subclass 2w.

Md—Medway silt loam. This nearly level, moderately well drained soil is on flood plains. It is subject to flooding for short periods.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. It is underlain by a dark brown silt loam subsurface layer about 10 inches thick. The subsoil between depths of 18 and 40 inches is mottled, yellowish brown silt loam. The substratum to a depth of 60 inches is stratified sandy loam and gravelly loamy sand.

Included with this soil in mapping are small areas of Sloan and Shoals soils. Areas of this Medway soil, along the Sandusky River, are slightly higher than the adjacent lower lying alluvial soils. These areas are less likely to flood.

This soil has moderate permeability. Available water capacity is high. Runoff is slow, but internal drainage is adequate for most cultivated crops. Content of organic matter in the surface layer is high. The root zone is deep. Reaction in the root zone is mostly neutral throughout. This soil is easily tilled over a wide range of moisture conditions. Few stones are present.

Most areas of this soil are used for cultivated crops and are well suited to irrigation. The more flood-prone areas commonly are in woodland or pasture. Growth rate of timber is high, and limitations for woodland are few.

This soil has few limitations for cultivated crops, except the hazard of flooding. In some areas, streambank erosion and gouging by floodwater are concerns. Flooding most commonly occurs during winter and early in spring; therefore, crops that mature in mid or late season are seldom damaged. This soil is suited to row crops commonly grown in the county and to special crops. Tillage should be timed to reduce loss of surface soil and crop residue by floodwater. Fall tillage that partly covers crop residue and leaves a rough surface is desirable to minimize soil and residue losses. Planting winter cover crops is also beneficial. Special high water channels that have a dense grass cover help in carrying peak flood flow without damage to cropland. Diversion of water from nearby upland soils can reduce crop-damaging surface flow during the growing season. Pasture on this soil commonly needs weed control and reseeding to improve varieties of grasses.

This soil has severe limitations for most engineering uses. It well suited to such nonfarm uses as paths and trails that are not affected by flood damage. Structures that are placed on this soil need to be protected from flooding and designed so as not to obstruct floodwater. This soil is a good source of topsoil. Capability subclass IIw; woodland suitability subclass 1o.

MkA—Mitiwanga silt loam, 0 to 3 percent slopes. This nearly level, somewhat poorly drained soil is in two distinct landform positions: adjacent to intermittent streams and in broad areas on uplands. It formed in glacial till underlain by sandstone bedrock at a depth of 20 to 40 inches. Areas that are adjacent to intermittent streams have slopes of 0 to 1 percent; broad areas in the uplands have slopes of 1 to 3 percent.

Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The subsurface layer is mottled, yellowish brown silt loam about 4 inches thick. The subsoil is mottled, yellowish brown and is about 23 inches thick. It is silty clay loam and clay loam in the upper part and is sandy loam immediately above the sandstone bedrock at a depth of 34 inches.

Included with this soil in mapping are many small areas of soils that are underlain by loose, flat fragments of sandstone instead of solid sandstone bedrock. Also, the depth to bedrock is quite variable. Some spots have bedrock at a depth of less than 20 inches; other places have bedrock at a depth of more than 40 inches; and in some places bedrock outcrops at the surface.

This soil has moderate permeability. Available water capacity is moderate. Runoff is slow. The root zone is moderately deep. Reaction is very strongly acid to medium acid. Content of organic matter in the surface layer is moderate.

Most areas of this soil are used for pasture, cropland, or woodland, but some areas are idle. This soil has good potential for most crops if drainage and fertility are improved. It also has good potential for woodland, wildlife habitat, and recreational uses. The main limitation of this soil is a seasonal high water table in winter, spring, and during prolonged rainy periods. The depth to bedrock is also a limitation for some uses, especially engineering uses that require excavation.

Artificial drainage is beneficial to most crops, but tiling is difficult because of the limited depth to bedrock. Surface drainage is also effective in removing excess water. Surface and subsurface drainage outlets need improvement in most areas. If this soil is undrained, planting is commonly delayed until June. Plant root development is restricted by a saturated subsoil early in the season and results in moisture stress when the upper layers of the soil become dry in summer.

The surface layer forms a crust after heavy rain, and this reduces infiltration. Additions of crop residue and manure and the use of minimum tillage help maintain or improve the structure of the surface layer.

This soil has a wetness hazard for residential development. Also, the moderate depth to bedrock is a limitation, but it provides a solid foundation for structures. Seasonal wetness and depth to bedrock limit the use of this soil for septic tank absorption fields. Capability subclass IIIw; woodland suitability subclass 3w.

Mu—Muskego muck. This level, very poorly drained soil is at the edge of extensive bogs or in depressions or potholes on ground moraines and end moraines. It formed in moderately deep organic deposits over coprogenous material.

Typically, the surface layer is black muck about 9 inches thick. Below this, between depths of about 9 and 20 inches, is very dark brown and very dark grayish brown muck. The underlying layers to a depth of about 60 inches are olive gray and olive sedimentary peat and silt that contains many small shells.

Included with this soil in mapping are spots of Carlisle soils, mainly near the center of small depressions or potholes. Where this soil is in fringe areas of larger, closed depressions, Carlisle soils are in the center of the depressions. Where the soil is adjacent to upland soils at the edge of depressions, the organic layers are very thin, and in places, light colored coprogenous (sedimentary peat) or marl material is exposed at the surface. These exposed materials are extremely hard and cloddy when dry.

This soil has moderate permeability in the organic part and slow permeability in the underlying material. Available water capacity is high. The root zone is moderately deep when this soil is drained. Content of organic matter in the surface layer is very high. This soil is subject to ponding, and the natural water table is near the surface during most of the year. It receives runoff and seepage from adjacent soils.

This soil is suited to most locally grown crops and some specialty crops if it is adequately drained. It has good potential for these uses but poor potential for most engineering uses. A few of the larger areas of this soil have been drained by tile and are used for vegetable and field crop production. Most areas are undrained and remain covered with such native bog plants as cattail, sedges, and swamp shrubs.

Artificial drainage is essential for efficient crop production. Outlets are expensive to construct and maintain in most areas. Ditchbanks are unstable. Subsidence caused by drainage results in tile displacement. Because of the looseness of this soil, soil blowing is a major hazard in the larger drained areas. Cultivating this soil is different than cultivating mineral soils, because the loose, porous surface layer requires very little energy to till. The surface layer commonly needs compacting rather than loosening to create a good seedbed. The high content of organic matter makes the soil very absorbent of water and nutrients. Trace element deficiencies are more common in this soil than in mineral soils.

This soil is well suited to irrigation if an adequate drainage system is installed. Subirrigation through tile lines by controlling the water table is feasible. Because of the low position of this soil in the landscape, plants that grow on it are more susceptible to frost than those that grow in nearby soils. In large areas of this soil, windbreaks or ground cover are needed to control blowing of loose, dry soil. Controlling the water table level in this soil helps control rapid subsidence, burning, and blowing. Weed control is a special concern because herbicides need to be applied at a higher rate than usual to be effective.

Extreme wetness reduces the potential for woodland, but the soil is excellent for wetland wildlife. This soil is highly valued in some places for sod production since it produces a dense sod more quickly than mineral soils and has less weight for shipment.

This soil is poorly suited to residential or commercial uses. Because of the high water table and high content of organic matter, the soil is compressible and low in strength. Where this soil must be used for a structure site, a piling or floating type foundation is suggested. Earthfill can be placed at the edge of the muck and gradually can displace the less dense organic layers. Capability subclass IVw; woodland suitability subclass 3w.

On—Olentangy mucky silt loam. This level, very poorly drained soil is in depressions in old lakebeds. It formed in organic and mineral lake sediment. Most areas of this soil are along the margins of large basins or in the centers of small depressions or potholes.

Typically, the surface layer is black mucky silt loam about 9 inches thick. Below this, to a depth of about 48 inches, is dark brown and dark greenish gray silt loam that is 5 to 25 percent organic material. The substratum to a depth of about 60 inches is dark greenish gray silt loam.

Included with this soil in mapping, mainly near the center of most areas, are small areas of Muskego soils. Lenawee Variant silty clay loam is included in some areas. Near the edge of most areas are spots of mineral soils, mainly Bono, Lenawee, and Luray. Also included are small areas where the organic material has been burned and a reddish yellow silty residue remains.

This soil has moderate permeability in the upper part and slow permeability in the underlying mineral material. It has high available water capacity and a deep root zone. Reaction in the root zone is extremely acid to mildly alkaline. Content of organic matter in the surface layer is very high. This soil has a high water table most of the year and is subject to ponding during periods of heavy rainfall. The organic layers disappear at a rate of about one-half inch to one inch per year when the water table is lowered.

This soil is suited to most locally grown crops and some specialty crops if it is adequately drained. It has fair potential for these uses, but poor potential for most engineering uses. A few areas of this soil have been drained by tile and are used for vegetable and field crop production. Most areas are undrained and remain covered with such native bog plants as cattail, sedges, and swamp shrubs.

Artificial drainage is essential for efficient crop production on this soil. Outlets are expensive to construct and maintain in most areas. Ditchbanks are unstable. Subsidence caused by drainage results in tile displacement. Because of the looseness of the surface layer, soil blowing is a major hazard in the larger drained areas. Cultivating this soil is different than cultivating mineral soils, because the loose, porous surface layer requires very little energy to till. The surface layer commonly needs compacting rather than loosening to create a good seedbed. The high content of organic matter makes the soil very absorbent of water and nutrients. Deep tillage brings up mineral material, which if allowed to dry, becomes hard, cloddy, and difficult to rewet.

This soil is well suited to irrigation if an adequate drainage system is installed. Because of the low position of this soil in the landscape, plants that grow in it are more susceptible to frost than those that grow in nearby soils. In large areas windbreaks or ground cover are needed to control blowing of loose, dry soil. Weed control is a special concern because herbicides need to be applied at a higher rate than usual to be effective.

Extreme wetness makes this soil poorly suited to woodland, but the soil is excellent for wetland wildlife. The soil has good potential for sod production in drained areas because it produces a dense sod more quickly than mineral soils and has less weight for shipment.

This soil is poorly suited to residential or commercial uses. Because of the high water table and high content of organic matter, the soil is compressible and low in strength. Where this soil must be used for a structure site, the use of a piling or floating type foundation is suggested. Capability subclass IIIw; woodland suitability subclass 5w.

Os—Olmsted silty clay loam. This nearly level, very poorly drained soil is on terraces, outwash plains, deltas, and some morainic uplands. It formed in loamy and sandy outwash that contains some gravel.

Typically, the surface layer is very dark grayish brown silty clay loam about 10 inches thick. The subsoil is about 30 inches thick. The upper part of the subsoil is dark gray and light brownish gray clay loam and loam, and the lower part is dark grayish brown and yellowish brown silt loam. The substratum to a depth of about 60 inches is very dark gray and dark gray gravelly loamy sand and sand.

Included with this soil in mapping are spots of Marengo, Luray, and Lenawee soils. Also included are small areas of soil that have a dark surface layer more than 10 inches thick, areas that are mildly alkaline in the subsoil, and some small areas that are in the lower part of depressions and are subject to ponding.

This soil has moderate permeability in the upper part of the soil and moderately rapid permeability in the underlying gravel and sand layers. Available water capacity is high. Seepage from adjoining higher level soils also contributes to high moisture levels throughout the year. Runoff is slow. Subsurface drainage has effectively removed excess water in most areas; therefore, the root zone is deep. Reaction in the root zone is medium acid to neutral. Content of organic matter in the surface layer is high.

Most areas of this soil have been drained and are cultivated. Corn, soybeans, small grain, and hay are the principal crops. This soil is well suited to such specialty crops as sugarbeets or vegetables. It has good potential for cropland but fair to poor potential for most engineering uses.

The high water table is the primary limitation for crop production. Surface and subsurface drainage is very effective in lowering the water table. Drainage outlets are difficult to establish in places. Tillage that leaves a rough or ridged surface improves soil-air movement and speeds soil drying in spring. Partial covering of crop residue also enhances soil drying. Reducing the number of trips by machinery across the field helps control soil compaction. To avoid compaction, pasturing should be controlled when this soil is wet. This soil is suited to irrigation, but crops seldom show moisture stress. Woodland management should favor growth of water-tolerant species. Wetness limits equipment operation and increases the hazard of tree windthrow.

The saturated subsoil is generally part of an extensive gravel and sand aquifer in the substratum. Shallow wells are dependent on this aquifer. The hazard of contamination of ground water is present when the soil is used for waste disposal. Cutbanks can have poor stability, especially when this soil is saturated. This should be considered when designing and constructing channels, foundations, and roads. The most effective means of improving soil stability is by removing excess water. This can be accomplished by grading to remove surface water, installing foundation drains, and improving outlets where necessary. Because of the seasonal high water table and low position on the landscape, this soil is poorly suited to homesites and septic tank absorption fields. Capability subclass IIw; woodland suitability subclass 2w.

Pm—Pewamo silty clay loam. This nearly level, very poorly drained soil is on broad flats, in closed depressions, and in small upland drainageways. It formed in calcareous glacial till.

Typically, the surface layer is very dark grayish brown silty clay loam about 10 inches thick. The subsoil is about 59 inches thick. The upper part of the subsoil is mottled, grayish brown and gray silty clay loam, and the lower part is mottled, yellowish brown and dark yellowish brown silty clay loam. The substratum to a depth of 93 inches is dense, olive brown clay loam, calcareous glacial till.

Included with this soil in mapping are areas of soil that have as much as 4 percent slopes on the sides of natural watercourses, areas where the surface layer is silt loam, and areas where the surface layer is clay. In some areas are spots of Condit soils. Also included are the somewhat poorly drained Bennington or Blount soils on small knolls and ridges and some small areas of soils that are in the lower part of depressions and are subject to ponding.

This soil has moderately slow permeability. Available water capacity is high. Content of organic matter in the surface layer is high. Runoff is very slow. Artificial drainage is needed for production of most crops. Tilth is generally good, although some of the more clayey areas become cloddy if plowed when too wet. The root zone is deep in areas that are drained. Reaction in the root zone in most areas is medium acid to neutral.

Most of the larger areas of this soil are drained and used for corn, soybeans, and small grain. Undrained areas are in permanent pasture or woodland.

This soil has a moderate wetness limitation, and artificial drainage for cultivated crops is beneficial. Unless surface water is removed and the water table is lowered, the growing season is shortened by delayed planting in spring. The soil remains wet into June in most years. Even in relatively drier years, the shallow water table during spring limits depth of root development of most crops and commonly results in moisture stress during the later part of the growing season. Harvesting operations are also hampered in areas that are not adequately drained. Occasional stones are present in some areas, and they limit the use of drainage equipment. Grassed waterways are needed where large amounts of water concentrate in overland flow.

This soil has a high capacity to store and release nutrients for plant growth. It is subject to compaction when heavy machinery is used. Management practices that maintain tilth in this soil are tillage at the proper moisture condition, good use of available crop residue, and growing deep-rooted legumes and grasses.

Plantings for pasture and woodland should include species that will tolerate wetness. During wet periods, the use of equipment is limited.

This soil is plastic when wet. It has a wetness limitation for residential development. Drainage improves strength and workability of the soil. Surface water management and foundation drainage are needed around most structures. Restricted permeability and the seasonal high water table make this soil poorly suited to sewage effluent disposal by standard design systems. The shrink-swell potential of this soil can cause damage to pavements and walls. Extra thickness or reinforcement of foundation material is needed to prevent cracking. Capability subclass IIw; woodland suitability subclass 2w.

Sb—Sebring silt loam. This nearly level, poorly drained soil is on broad flats and in shallow depressions. It formed in lacustrine sediment that is high in silt content.

Typically, the surface layer is dark grayish brown silt loam about 9 inches thick. The subsoil between depths of about 9 and 45 inches is mottled, dark gray and gray silty clay loam. The substratum to a depth of 65 inches is stratified layers of dark yellowish brown silt loam and very fine sand.

Included with this soil in mapping are small areas of soils that have a silty clay loam surface layer 5 to 8 inches thick; areas of this soil in the Willard Marsh that have weakly developed structure and a dense subsoil; and areas that are near Tiro or Bennington soils and have dense clay loam glacial till at a depth of 3 to 5 feet. Also included are small areas of Luray or Lenawee soils.

This soil has moderately slow permeability. Available water capacity is moderate. The root zone is deep when the soil is drained. Crops seldom show evidence of moisture stress on this soil. Runoff is slow, and some areas are subject to the ponding of water. Content of organic matter in the surface layer is moderate.

This soil is used mainly for cropland. Principal crops are corn, soybeans, wheat, and meadow. Undrained areas are in native wetland (swamp); in hardwood forest; or in pasture that consists of coarse grasses, reeds, and sedges.

Wetness is the primary limitation for farming. Where the soil is only partly drained, planting is often delayed until June and harvesting operations are hampered by wetness. Surface and subsurface drainage is effective in removing excess water. Improvement of drainage outlets is needed in many areas. If drainage is installed, this soil is equal to nearby soils in productivity. This soil is subject to surface crusting after rainfall. A rough or ridged surface dries more quickly in spring by hastening soil-air circulation. Return of crop residue and manure and the use of minimum tillage help maintain or improve soil structure and tilth.

When this soil is saturated, it has low strength. The soil at a depth of 4 to 5 feet has low plasticity and is unstable in ditches or excavations. Removing excess water is the most effective means of increasing strength and stability of this soil. Earthfill is generally too wet for best compaction. When this soil is used for reservoir embankments, soil piping can be a concern.

For urban development, this soil needs major drainage to remove surface water and to lower the water table. Otherwise streets, basements, and excavations fill with water during rainy periods. Ice lens formation in the wet soil can cause severe frost heaving of pavements. This soil is a less desirable site in the county for dwellings. The moderately slow permeability and seasonal high water table are severe limitations for septic tank absorption fields. Capability subclass IIIw; woodland suitability subclass 2w.

Sh—Shoals silt loam. This nearly level, somewhat poorly drained soil is on flood plains. It formed in alluvium recently deposited by flowing streams and is subject to flooding. In larger flood plains along major streams, this soil is in low areas away from the main channel. Along smaller streams, it dominates the narrow flood plains.

Typically, the surface layer is dark grayish brown silt loam about 11 inches thick. The subsoil is about 29 inches thick. The upper part of the subsoil is mottled, brown or grayish brown silt loam, and the lower part is mottled, gray loam. The substratum to a depth of about 60 inches is gray loam and gravelly loam.

Included with this soil in mapping are Sloan soils in depressions and along former stream channels. Near the present stream channel and on the elevated parts of the flood plain are small areas of Lobdell soils. Also included are small areas of soil that have a surface layer of loam, sandy loam, and silty clay loam.

This soil has moderate permeability. Available water capacity is high. Runoff is slow. This soil is subject to frequent brief flooding, and in some areas water ponds for brief periods after the floodwater recedes. Flood highwater marks; surface deposits of fresh alluvium; and accumulation of logs, branches, stalks, and other organic debris are indicators of frequent flooding in most areas. The root zone is deep. Reaction is slightly acid to mildly alkaline. Content of organic matter in the surface layer is moderate. This soil is saturated near the surface during wet seasons.

The use of this soil depends on the degree of protection from flooding and the extent to which adequate drainage is provided. Some areas of this soil in the wider valleys are used for cropland. Most areas in the narrower valleys are used as permanent pasture or woodland, because of their inaccessibility and the difficulty in providing adequate drainage. This soil has good potential for cropland, pasture, and woodland. It has poor potential for most engineering uses and some recreational uses, because of the flood hazard, high frost action potential, and low strength.

This soil is suited to most crops if drainage and protection from flooding are provided. If outlets are available, subsurface drainage is effective in lowering the water table for crop production. Frequent flooding in winter and spring is especially detrimental to small grain. Flooding during the growing season is less common, and such crops as corn and soybeans can often be grown without flood damage. This soil is well suited to pasture, but grazing should be avoided when the soil is wet. Seasonal wetness that causes equipment limitations is the main restriction to woodland. Wetness also affects which species of trees should be planted.

This soil is generally unsuited to homesites, camp sites, and other nonfarm uses, because of wetness and the hazard of flooding. Some areas are protected by flood-control measures. The seasonal water table can be lowered by drainage in some areas thus permitting more intensive uses. Streambank stabilization is needed in some areas to control erosion. Capability subclass IIw; woodland suitability subclass 2w.

So—Sloan silt loam. This nearly level, very poorly drained soil is in flat to depressional areas on the flood plains along major streams. It formed in sediment recently deposited by flowing streams.

Typically, the surface layer is very dark gray silt loam about 12 inches thick. The subsoil between depths of about 12 and 48 inches is very dark grayish brown to light olive brown silt loam. The substratum to a depth of about 75 inches is yellowish brown loam.

Included with this soil in mapping are a few areas of soil that have a surface layer of silty clay loam or mucky silt loam.

This soil has moderate permeability. Available water capacity is high. This soil is subject to frequent flooding. Runoff is slow, and in some areas water ponds for short periods after floodwater has receded. In addition to excess surface water, the ground water table is at the surface during wet seasons. The root zone is deep in adequately drained areas. Content of organic matter in the surface layer is high.

Most areas of this soil are used for pasture or cropland. Some areas are wooded. Very little of this soil has been used for urban development. This soil has good potential for cropland where it is drained, but it has poor potential for most engineering uses. Land use depends on adequate drainage, the degree of the flooding hazard, and the duration of ponding.

Natural wetness and the flooding hazard are limitations for most farm uses. Frequent floods in winter and spring are especially detrimental to small grain; however, flooding during the growing season is less common and such crops as corn and soybeans can often be grown without flood damage. This soil is well suited to pasture, but grazing should be avoided when the soil is wet. Seasonal wetness that causes equipment limitations is the main restriction to woodland. Wetness also affects which species of trees should be planted.

This soil is poorly suited to homesites, camp sites, and most other nonfarm uses because of the hazard of flooding and the prolonged wetness. Some areas of this soil are protected by flood-control measures. Also, the seasonal water table can be lowered by drainage in some areas, thus permitting more intensive uses. Streambank stabilization is needed in some areas to control erosion. Capability subclass IIIw; woodland suitability subclass 2w.

TrA—Tiro silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on the higher positions on the landscape. It formed in glacial lake sediment and the underlying glacial till. The lake deposits are mainly silt, but layers of fine sand occur near the contact with glacial till. Most areas of this soil are large in size.

This soil receives very little runoff from adjoining soils. Relief in most areas is only 2 to 3 feet.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil is about 38 inches thick and is mainly mottled, yellowish brown and gray. It is silty clay loam in the upper part and loam in the lower part. The substratum to a depth of 72 inches is brown clay loam glacial till.

Included with this soil in mapping are small areas of Bennington and Fitchville soils and spots of Kibbie, Sebring, Condit, and Luray soils.

This soil has moderately slow or slow permeability in the lower part of the subsoil and in the substratum. Available water capacity is moderate. Runoff is slow. The root zone is deep when this soil is drained. Reaction in the root zone is very strongly acid to mildly alkaline. Content of organic matter in the surface layer is moderate.

Most areas of this soil are used for cropland. This soil has good potential for cropland where it is drained. Corn, soybeans, small grain, and grass-legume meadow are the principal crops. This soil has fair potential for most engineering uses.

Excess water during rainy periods is the main concern for most intensive uses. Subsurface drainage is effective in lowering the water table, allowing for more timely tillage, and deepening the root zone.

Erosion is a slight hazard. The silty surface layer is subject to crusting, which reduces infiltration and can cause temporary ponding after heavy rains. Although available water capacity is moderate in the root zone, a shortage of water seldom limits plant growth where drainage has been improved.

The layers in the upper part of this soil that formed in water-deposited sediment have lower strength than the underlying glacial till. This should be considered in designing ditches, small buildings, and roads. Foundations of heavy buildings should extend to the underlying glacial till. Because of slow permeability and the seasonal high water table, this soil is poorly suited to septic tank absorption fields. It has fair to good suitability for most woodland, wildlife habitat, and recreational uses. Capability subclass IIw; woodland suitability subclass 2w.

TrB—Tiro silt loam, 2 to 6 percent slopes. This gently sloping, somewhat poorly drained soil commonly is on the higher positions on the landscape. It formed in glacial lake sediment and the underlying glacial till. Most areas of this soil are moderate in size. Some areas receive runoff from adjoining soils.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil is about 35 inches thick and is mainly mottled, yellowish brown and gray. It is silty clay loam in the upper part and loam in the lower part. The substratum to a depth of 60 inches is brown clay loam glacial till.

Included with this soil in mapping are small areas of Bennington and Fitchville soils and spots of Kibbie, Sebring, Condit, and Luray soils.

This soil has moderately slow to slow permeability in the lower part of the subsoil and in the substratum. Available water capacity is moderate. Runoff is medium. The root zone is deep when this soil is drained. Reaction in the root zone is very strongly acid to mildly alkaline. Content of organic matter in the surface layer is moderate.

Most areas of this soil are used for cropland. Excess wetness during winter and spring is a limitation for most uses. This soil has good potential for cropland when it is drained. Corn, soybeans, small grain, and grass-legume meadow are the principal crops. This soil has fair potential for most engineering uses.

The hazard of erosion is moderate when this soil is used as cropland. Minimum tillage, sod waterways, rotations that include meadow crops, and practices that shorten the length of slope are effective in controlling runoff and erosion.

Subsurface drainage is effective in lowering the water table. Drainage allows for more timely tillage and a deeper root zone. The silty surface layer is subject to crusting, which reduces infiltration and increases runoff. Although available water capacity is moderate in the root zone, a shortage of water seldom limits the plant growth where drainage has been improved.

The layers in the upper part of this soil that formed in water-deposited sediment have lower strength than the underlying glacial till. This should be considered in designing ditches, small buildings, and roads. Foundations of heavy buildings should extend to the underlying glacial till. Because of slow permeability and the seasonal high water table, this soil is poorly suited to septic tank absorption fields. It has fair to good potential for most woodland, wildlife habitat, and recreational uses. Capability subclass IIe; woodland suitability subclass 2w.

TsB—Tuscola fine sandy loam, 2 to 6 percent slopes. This gently sloping, moderately well drained soil is on knolls or ridges that commonly are highest points in the local relief and on low terraces a few feet above the flood plains of major streams. This soil formed in calcareous, water-deposited sediment along the margin of former glacial lakes.

Typically, the surface layer is dark grayish brown fine sandy loam about 8 inches thick. The subsoil is about 38 inches thick. The upper part of the subsoil is yellowish brown, brown, and dark yellowish brown sandy loam; and the lower part is dark brown and dark yellowish brown clay loam and sandy clay loam. Gray mottles are below a depth of 16 inches. The substratum to a depth of 66 inches is stratified sandy loam and silt loam.

Included with this soil in mapping are small areas of soils that have a thin gravelly layer in the lower part of the subsoil.

This soil has moderate permeability. Available water capacity is high. The root zone is deep. Reaction is medium acid to neutral. Content of organic matter in the surface layer is moderately low. Runoff is medium. Surface water seldom accumulates on this soil. This soil dries more rapidly than the surrounding soils, but a seasonal water table in the lower part of the subsoil can limit tillage or other operations for brief periods.

This soil is well suited to cropland. It is well suited to early-season crops. Most areas of this soil are cultivated. Corn, soybeans, small grain, and hay are the principal crops. A few areas are in woodland. This soil has fair potential for homesites and other engineering uses. It is also suited to irrigation and can be very productive for a wide variety of vegetable crops.

The main limitation is a moderate hazard of erosion. This soil erodes easily by water or wind. Minimum tillage, winter cover crops, and grassed waterways help prevent excessive soil loss. Returning crop residue or adding other organic material to the soil helps to improve fertility, reduce crusting, and increase water infiltration. Natural drainage is generally adequate for farming, but random tile lines are beneficial in draining wet spots along waterways and in depressions.

This soil has fewer limitations for most uses than nearby soils. The water table is less of a concern than in most surrounding soils, and the rate of water movement is favorable for septic tank absorption systems except during short periods of a high water table. Excavation trenches can slump or have water seepage during wet seasons. This soil dries earlier than other surrounding soils. Unstable layers and seepage around foundations are the main concerns for dwellings. Foundation drains help minimize stability and seepage. Foundations and roadways are subject to damage by frost heaving, because the frost action potential on this soil is high. This soil has a narrow range of moisture when good compaction is possible. Capability subclass IIe; woodland suitability subclass 1o.

TuB—Tuscola-Bennington complex, 2 to 6 percent slopes. These gently sloping soils are on low knolls or ridges near the margin of former glacial lake basins. The Tuscola soils formed in water-deposited sediment and are moderately well drained. The Bennington soils formed in glacial till and are somewhat poorly drained. Most areas are about 30 percent Tuscola fine sandy loam, 30 percent Bennington silt loam, and 40 percent other soils that have properties similar to those of Tuscola or Bennington soils. Tuscola and Bennington soils are so intricately mixed that it is not practical to map them separately.

Typically, the Tuscola soils have a dark grayish brown fine sandy loam surface layer about 8 inches thick. The subsoil is about 32 inches thick. It is yellowish brown, brown, and dark yellowish brown sandy loam in the upper part and dark brown and dark yellowish brown clay loam and sandy clay loam in the lower part. Gray mottles are below a depth of 15 inches. The substratum to a depth of about 60 inches is stratified sandy loam and silt loam.

Typically, the Bennington soils have a dark grayish brown silt loam surface layer about 8 inches thick. The subsoil between depths of about 8 and 40 inches is mottled, yellowish brown and dark brown silty clay loam and silty clay. The substratum to a depth of about 60 inches is dark grayish brown clay loam glacial till.

Included with these soils in mapping are spots of Condit and Marengo soils in slight depressions and along waterways. Small areas of the somewhat poorly drained Tiro and Kibbie soils are also included.

These soils are used mainly for cropland. Corn, soybeans, small grain, and hay are the principal crops. These soils have good potential for cropland and fair potential for most engineering uses.

The hazard of erosion is moderate where these soils are cultivated. Minimum tillage, winter cover crops, and grassed waterways help prevent excessive soil loss. Returning crop residue or adding other organic material to these soils helps to improve fertility, reduce crusting, and increase water infiltration. Natural drainage is generally adequate for farming, but random tile lines are beneficial in draining wet spots along waterways and in depressions.

The Bennington soils have a moderate wetness hazard and remain wet longer in spring than the Tuscola soils. Subsurface drainage is effective in lowering the water table. The Bennington soils are subject to surface crusting after heavy rain. The crust reduces infiltration, increases runoff, and restricts seedling emergence.

Low strength in the Tuscola soils and the high water table in Bennington soils are limitations for homesites, roads, and other engineering uses. Deep cuts in the Tuscola soils are subject to slumps or slippage, especially during wet seasons. Foundation drains help minimize stability and seepage in homes with basements. Drainage also reduces the hazard of frost action on the soils. Capability subclass IIe; woodland suitability subclass: Tuscola soils in 1o, Bennington soils in 2w.

Ud—Udorthents, loamy. Earthmoving has altered or mixed the surface layer, subsoil, and underlying layers so that most original soil profile features are absent or deeply buried in this soil. The soil in these areas is mostly level to gently sloping, but short, very steep banks are present. Most areas are the result of cutting or filling. Soil exposed in excavations is similar to the substratum of other nearby soils. Earthfills are more compacted and less permeable than the subsoil of nearby soils.

This soil is along major highways, railroads, and airport runways; near reservoirs and quarries; and on athletic fields. It is commonly included in mapping Urban land complexes in the county.

This soil has poor tilth and is poorly suited to gardens and lawns. Reaction is commonly alkaline. Fertility and available water capacity are low. The root zone is commonly shallow. Most areas are very firm and compacted. In unvegetated areas, runoff is very high, and the hazard of erosion is severe. This soil has good strength where it is well compacted.

Blanketing with topsoil helps establish ground cover. Seedings should be mulched. Holding basins to control peak runoff and sediment helps reduce stream pollution. Capability subclass and woodland suitability subclass not assigned.

Ur—Urban land. Urban land consists of areas that are about 80 to 90 percent covered with buildings, streets, and sidewalks. Most areas are in the cities and make up the central or business districts and closely built-up sections.

In most areas of this map unit, the underlying soil could not be observed. A few spots that are not covered consist of disturbed and mixed soil material or isolated profiles of natural soil. These are mostly in the old residential sections or in parks or cemeteries.

Slopes are mainly level or gently sloping. More sloping areas are modified by retaining walls, terraces, or extensive reshaping. Natural water tables have been lowered somewhat by storm and foundation drainage systems. Natural surface drainage courses are covered or fed into storm drainage conduits. Runoff is very rapid and has a very high peak flow. Flooding of basements in low areas is common during intense storms. Capability subclass and woodland suitability subclass not assigned.

WaA—Wadsworth silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil formed in glacial till that is low in content of lime. This soil has a fragipan in the subsoil that restricts the downward movement of water.

Typically, the surface layer is dark grayish brown silt loam about 9 inches thick. The subsurface layer is grayish brown silt loam about 3 inches thick. The upper part of the subsoil, to a depth of about 24 inches, is mottled, yellowish brown silty clay loam. The fragipan between depths of 24 and 36 inches is mottled, very firm, yellowish brown and dark brown silty clay loam and clay loam. The lower part of the subsoil and substratum to a depth of about 65 inches is mottled, dark brown clay loam.

Included with this soil in mapping are small areas of soil that are silty to a depth of 30 inches and have a fragipan that is deeper than in other areas. Also included are spots of Condit soils in slight depressions and some areas of Bennington soils.

This soil has slow or very slow permeability in the fragipan. Available water capacity is moderate. The root zone is restricted by the fragipan. Reaction in the root zone is mostly medium acid to extremely acid. Runoff is slow, and the water table is perched near the surface during winter and spring. Content of organic matter in the surface layer is moderate.

This soil is used mainly for cropland. Corn, soybeans, wheat, and meadow are the principal crops. South of Galion many fields are no longer cultivated, and some areas are being converted to residential development. A few areas are in native hardwood forest. This soil has fair potential for cropland and most engineering uses.

If this soil is in cropland, it has a moderate wetness hazard in spring and a moisture stress in summer. It is acid in the root zone, generally low in fertility, and subject to crusting after heavy rain. This soil is one of the more difficult soils in the county on which to achieve consistently high crop production. Surface and subsurface drainage is effective in lowering the water table. Drainage outlets need to be established or improved in many areas. Without systematic drainage, an intensive cropping system is not feasible. A rough or ridged surface tends to dry more rapidly by enhancing soil-air movement. Additions of crop residue and manure, the use of minimum tillage, and the inclusion of deep-rooted legumes in the rotation maintain or improve tilth.

This soil is suited to woodland. Growth rate of adapted trees is high. Soil wetness can hamper harvesting during winter and spring.

Seasonal wetness and slow or very slow permeability are the main hazards for residential and commercial development. Otherwise, this soil has good strength and stability in excavation cutbanks and as foundations of small structures. The seasonal high water table creates saturated soil layers near the surface that are soft and sticky. Frost heaving is also a severe hazard. Foundation drains and surface grading to remove excess water reduce water-related concerns. This soil is favorable for use in embankments, dikes, and levees, except that wetness is a limitation to good compaction in most seasons. The slowly or very slowly permeable fragipan is a severe limitation to septic tank absorption fields. Capability subclass IIIw; woodland suitability subclass 2w.

WaB—Wadsworth silt loam, 2 to 6 percent slopes. This gently sloping, somewhat poorly drained soil formed in glacial till that is low in content of lime. This soil has a fragipan in the subsoil that restricts the downward movement of water.

Typically, the surface layer is dark grayish brown silt loam about 9 inches thick. The upper part of the subsoil, to a depth of about 20 inches, is mottled, yellowish brown silty clay loam. The fragipan between depths of 20 and 34 inches is mottled, very firm, yellowish brown and dark brown silty clay loam and clay loam. The lower part of the subsoil and substratum to a depth of about 60 inches is dark brown clay loam.

Included with this soil in mapping are spots of Condit soils in slight depressions and some areas of Bennington soils.

This soil has slow or very slow permeability in the fragipan layer. Available water capacity is moderate. The root zone is restricted by the fragipan. Reaction in the root zone is mostly medium acid to extremely acid. Runoff is medium, and the water table is perched near the surface during winter and spring. Content of organic matter in the surface layer is moderate.

This soil is used mainly for cropland. Corn, soybeans, wheat, and meadow are the principal crops. South of Galion many fields are no longer cultivated, and some areas are being converted to residential development. A few areas are in native hardwood forest. This soil has good potential for cropland and fair potential for most engineering uses.

If this soil is in cropland, it has a moderate wetness hazard in spring and a moisture stress in summer. It has a moderate hazard of erosion. Most areas of this soil are acid in the root zone, generally low in fertility, and subject to crusting after heavy rain. This soil is one of the more difficult soils in the county on which to achieve consistently high crop production. Subsurface drainage is effective in lowering the water table. Drainage outlets need to be established or improved in many areas. Without systematic drainage, an intensive cropping system is not feasible. A rough or ridged surface tends to dry more rapidly by enhancing soil-air movement. Additions of crop residue and manure, minimum tillage, sod waterways, and the inclusion of deep-rooted legumes in the crop rotation help control erosion and maintain or improve tilth. Practices that shorten the length of slope can aid in controlling runoff and erosion. Drainage is needed, however, for these practices to be effective. Lime and fertilizers should be applied according to soil tests and crop needs.

This soil is suited to woodland. Growth rate of adapted trees is high. Soil wetness can hamper harvesting during winter and spring.

Seasonal wetness and slow permeability are the main hazards for residential and commercial development. Otherwise, this soil has good strength and stability in excavation cutbanks and as a foundation for small structures. The seasonal high water table creates saturated soil layers near the surface that are soft and sticky. Frost heaving is a severe hazard. Foundation drains and surface grading to remove excess water reduce water-related problems. This soil is favorable for use in embankments, dikes, and levees, but wetness is a limitation to good compaction in most seasons. The slowly permeable subsoil is a severe limitation to septic tank absorption fields. Capability subclass IIIw; woodland suitability subclass 2w.

Wb—Wallkill silt loam. This nearly level, very poorly drained soil is in small, deep depressions and in larger areas along the streams. This soil formed in alluvium and the underlying organic material. The lighter colored mineral part of the alluvium was washed from nearby uplands. This soil is subject to flooding or ponding, or both.

Typically, the surface layer is dark grayish brown silt loam about 9 inches thick. Between depths of 9 and 22 inches are layers of mottled, dark grayish brown and dark gray silt loam. Below this to a depth of 80 inches is black muck.

Included with this soil in mapping are small areas of soil in which the mineral layers are less than 16 inches in thickness or more than 30 inches.

This soil has moderate permeability. Available water capacity is high. The root zone is deep when the soil is drained. Reaction is strongly acid to mildly alkaline. Content of organic matter in the surface layer is moderate. Runoff is very slow. The water table is at the surface during the wettest time of the year.

Drained areas of this soil are used for cropland. Undrained areas are mostly used for pasture. Native plants consist of water-tolerant trees, shrubs, and grasses. This soil has good potential for cropland where it is drained, but it has poor potential for most other uses.

Wetness is a moderate hazard if this soil is used for farming. Surface and subsurface drainage is effective in lowering the water table. Drainage is not easily provided in some areas, because of the little elevation difference between this soil and that of nearby soils and streams. Stream channels commonly need to be deepened to provide drainage outlets. Levees have been constructed in some areas to control flooding.

Seasonal wetness, unstable organic layers, and the hazard of flooding are severe limitations for most engineering uses. This soil is a hazardous site for dwellings and other structures. Bank instability along drainage channels is a source of sediment for streams flowing through this soil. Capability subclass IIIw; woodland suitability subclass 4w.

WlA—Wilmer Variant silt loam, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on end moraines and outwash plains. It formed in glacial melt water deposits.

Typically, the surface layer is very dark brown silt loam about 13 inches thick. The subsoil between depths of about 13 and 50 inches is yellowish brown clay loam, sandy loam, and loam that has mottles below a depth of about 24 inches. The substratum to a depth of about 60 inches is dark brown clay loam glacial till.

Included with this soil in mapping are small areas of soil that are somewhat poorly drained, small areas of Elliott soils, and spots of Marengo soils, which are along waterways and in low areas.

This soil has moderate permeability. Available water capacity is moderate. The root zone is deep. Reaction is medium acid to neutral. Content of organic matter in the surface layer is high. Runoff is slow, and most areas receive additional surface water and seepage from nearby soils.

Most areas are used for cropland. This soil has good potential for cropland, woodland, pasture, and most engineering uses. Horticultural crops produce well on this soil.

This soil has few management concerns. It has good tilth and can be cultivated over a wide range of moisture conditions. The hazard of erosion is slight, except where water is concentrated. Sod waterways should be used in some areas to carry surface water. Random drainage is needed in wet spots. This soil is suited to irrigation.

A seasonal water table below a depth of about 20 inches can cause seepage in basements and bank cave-in in excavations. Footer drains help remove excess water around dwellings and structures. Some stones in this soil can interfere with trenching operations. This soil is a fair source of topsoil for final grading. Capability class I; woodland suitability subclass 2o.

WlB—Wilmer Variant silt loam, 2 to 6 percent slopes. This gently sloping, moderately well drained soil is on end moraines and outwash plains. It formed in glacial melt water deposits.

Typically, the surface layer is very dark brown silt loam about 12 inches thick. The subsoil between depths of about 12 and 45 inches is yellowish brown clay loam, sandy loam, and loam and has mottles below a depth of about 24 inches. The substratum to a depth of about 60 inches is dark brown clay loam glacial till.

Included with this soil in mapping are spots of Bogart, Chili, and Cardington soils on small knolls; small areas of Elliott soils; and spots of Marengo soils along waterways and in low areas.

This soil has moderate permeability. Available water capacity is moderate. The root zone is deep. Reaction is medium acid to neutral. Content of organic matter in the surface layer is high. Runoff is medium.

Most areas of this soil are used for cropland. This soil has good potential for cropland, woodland, pasture, and most engineering uses. Horticultural crops produce well on this soil.

This soil has a moderate hazard of erosion, especially in areas where water concentrates. Minimum tillage or no-tillage, meadow crops in the rotation, and sod waterways are commonly used to help control erosion.

This soil has good tilth and can be cultivated over a wide range of moisture conditions. Random drainage is needed for wet spots. This soil is suited to irrigation.

A seasonal water table below a depth of about 20 inches can cause seepage in basements and bank cave-in in excavations. Footer drains help remove excess water around dwellings and structures. Some stones in this soil can interfere with trenching operations. This soil is a fair source of topsoil for final grading. Capability subclass IIe; woodland suitability subclass 2o.

Use and management of the soils

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

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

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

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

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

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

Crops and pasture

R. W. SMITH, district conservationist, Soil Conservation Service, helped to 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 adapted 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 predicted yields of the main crops hay and pasture are presented for each soil.

This section provides information about the overall agricultural potential and needed practices of the survey area for those in the agribusiness sector—equipment dealers, drainage contractors, fertilizer companies, processing companies, planners, conservationists, and others. For each kind of soil, information about management is present in the section "Soil maps for detailed planning." When making plans for management systems for individual fields or farms, check the detailed information in the description of each soil.

More than 181,000 acres in the survey area was used for crops and pasture in 1967, according to the Conservation Needs Inventory (*9*). Of this total, about 102,000 acres was used for row crops, mainly corn and soybeans; 32,000 acres for close-grown crops, mainly wheat and oats; 31,000 acres for rotation hay and pasture; and the rest was idle cropland.

The potential of the soils in Crawford County for increased production of food is good. About 23,000 acres of potentially good cropland is currently used as woodland and permanent pasture. In addition to the reserve productive capacity represented by this land, food production could also be increased considerably by extending the latest crop production technology to all cropland in the county. This soil survey can greatly facilitate the application of such technology.

Soil drainage (fig. 7) is the major management need on about two-thirds of the acreage used for crops and pasture in the survey area. Some soils are naturally so wet that the production of crops common to the area is generally not possible without drainage. These are the poorly drained and very poorly drained Bono, Colwood, Condit, Lenawee, Luray, Marengo, Olmstead, Pewamo, Sebring, Sloan, and Wallkill soils, which make up about 80,000 acres in the survey area. Also in this category are the organic soils—Carlisle, Muskego, and Olentangy soils, which make up about 400 acres.

Unless artificially drained, the somewhat poorly drained soils are so wet that crops are damaged during most years and planting or harvesting is delayed. In this category are the Bennington, Blount, Del Rey, Elliott, Fitchville, Jimtown, Kibbie, Mitiwanga, Shoals, Tiro, and Wadsworth soils, which make up about 114,000 acres.

Small areas of wet soils along drainageways and in swales are commonly included in areas of the moderately well drained Cardington and Glynwood soils, especially those that have slopes of 2 to 6 percent. Artificial drainage is needed in areas of these wet soils.

The design of surface and subsurface drainage systems (fig. 8) varies with the kind of soil. A combination of surface drainage and tile drainage is needed in most areas of the poorly drained and very poorly drained soils that are used for intensive row cropping. Drains have to be more closely spaced in soils that have slow permeability than in the more permeable soils. Tile drainage is very slow in Bono, Lenawee Variant, and Wadsworth soils. Finding adequate outlets for tile drainage systems is expensive in many areas of Bono, Colwood, Lenawee, Luray, Marengo, Olmsted, Pewamo, Sebring, Sloan, and Wallkill 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 on drainage design for each kind of soil is given in the Technical Guide, available in local offices of the Soil Conservation Service.

Soil erosion is the major concern of about one-third of the cropland and pasture in Crawford County. If the slope is more than 2 percent, erosion is a hazard. Bennington, Blount, Fitchville, Jimtown, Kibbie, Tiro, and Wadsworth soils, for example, have slopes of 2 to 6 percent and an additional problem of wetness.

Loss of the surface layer by erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost, and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils that have a clayey subsoil, such as Glynwood soils, and on soils that have a layer in or below the subsoil that limits the depth of the root zone. Such a layer is the fragipan in the Wadsworth soils. Erosion also reduces productivity on soils that tend to be droughty, such as Chili loam. Second, erosion on farmland results in sediments entering the streams. Controlling erosion minimizes the pollution of streams caused by sediment and improves the quality of water for municipal use, recreation, and fish and wildlife.

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

Erosion control practices provide protective surface cover, reduce runoff, and increase infiltration. A cropping system that keeps vegetative cover on the soil for extended periods can keep erosion losses at an amount that will not reduce the productive capacity of the soils. On livestock farms which require pasture and hay, the legume and grass forage crops in the cropping system reduce erosion on sloping soils and provide nitrogen and improve tilth for the following crop.

Slopes are so short and irregular that contour tillage or terracing is not practical in most areas of the sloping Alexandria, Cardington, Chili, and Glynwood soils. On these soils, cropping systems that provide substantial vegetative cover are needed for erosion control, unless minimum tillage is practiced.

Minimizing tillage and leaving crop residue on the surface help to increase infiltration and reduce the hazards of runoff and erosion. These practices can be adapted to most soils in the survey area. No-tillage for corn is effective in reducing erosion on sloping land and can be adapted to most soils in the survey area. It is more difficult, however, to practice successfully on somewhat poorly drained to poorly drained soils.

Terraces and diversions reduce runoff, erosion, and the length of slope. They are most practical on deep, well drained soils that have regular slopes. Gallman soils are suitable for terraces. The other soils are less suitable for terracing and diversions because of irregular slopes, excessive wetness in the terrace channels, a clayey subsoil which would be exposed in terrace channels, or bedrock at a depth of less than 40 inches.

Soil blowing is a hazard on the muck soils—Carlisle, Muskego, and Olentangy soils. It can damage these soils in a few hours if winds are strong and if the soils are dry and bare of vegetation or surface mulch. Maintaining vegetative cover, surface mulching, and roughing surfaces by proper tillage minimizes soil blowing on these soils. Windbreaks of adapted shrubs, such as Tatarian honeysuckle or autumn olive, are effective in reducing soil blowing on the muck soils.

Information on the design or erosion control practices for each kind of soil is available in local offices of the Soil Conservation Service.

Natural soil fertility is low in most soils of the uplands. The soils on flood plains, such as Lobdell, Shoals, Sloan, and Medway are higher in plant nutrients than most upland soils. Luray, Bono, Lenawee, and Pewamo soils, in low swales and drainageways, are commonly slightly acid or neutral. Manganese deficiencies have been noted in soybeans on these poorly drained or very poorly drained soils.

Unless they have been limed, the organic Carlisle, Muskego, and Olentangy soils are commonly medium acid to strongly acid. These soils require special fertilizers, because they are low in boron and other trace elements.

Many upland soils are naturally acid in the upper layers, and if they have never been limed, they require applications of ground limestone to raise the pH level sufficiently for good growth of alfalfa and other crops that grow best on almost neutral soils. Available phosphorus and potash levels are naturally low in most of these soils. On all soils, additions of lime and fertilizer should be based on the results of soil tests, on the needs of the crop, and on the expected level of yields. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime to apply.

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

Most of the soils used for crops in the survey area have a silt loam surface layer that is light in color and moderate to low in content of organic mater. Generally, the structure of such soils is weak, and intense rainfall causes the formation of crust on the surface. The crust is hard when it is dry, and it reduces infiltration of water. When the crust forms, it retards germination and increases runoff. Regular additions of crop residue, manure, and other organic material can help to improve soil structure and reduce crust formation.

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

The darker colored Luray, Bono, Lenawee, and Pewamo soils are clayey, and tilth is a problem because the soils often stay wet until late in spring. If they are plowed when wet they tend to be very cloddy when dry and make good seedbeds difficult to prepare. Fall plowing generally results in good tilth in 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 row crops commonly grown. Grain sorghum, sunflowers, navy beans, potatoes, and similar crops can be grown if economic conditions are favorable.

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

Special crops grown commercially in the survey area are vegetables, small fruits, tree fruits, and nursery plants. Radishes, onions, and lettuce are grown in the organic soils of northern Auburn Township. A small acreage throughout the county is used for melons, strawberries, raspberries, popcorn, sweet corn, tomatoes, and other vegetables and small fruits. In addition, large areas can be adapted to other special crops, such as sugar beets, tomatoes, and other vegetables. Apples and cherries are the most important tree fruits grown in the county.

Deep soils that have good natural drainage and that warm early in spring are especially well suited to many vegetables and small fruits.

These are Alexandria, Chili, Bogart, Gallman, Lykens, Medway, Tuscola, and Wilmer Variant soils that have slopes of less than 6 percent. They make up about 8,000 acres in the survey area. Crops can generally be planted and harvested earlier on all these soils than on other soils in the survey area.

When adequately drained, the muck soils are well suited to a wide range of vegetable crops. Carlisle, Muskego, and Olentangy soils make up about 400 acres in the survey area.

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

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

Yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 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 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.

Cow-acre-days are not given for pasture in the table. They can be calculated from the hay fields indicated in table 5 by converting tons of hay to pounds by multiplying tons by 2,000 and then dividing by 40. The result is the cow-acre-days per year of pasture. Example: 5-ton hay yield multiplied by 2,000 equals 10,000 pounds. 10,000 divided by 40 equals 250 cow-acre-days per year of pasture.

Capability classes and subclasses

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

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 (*10*).

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 commonly occurring winds; *moderate*, that some trees are blown down during periods of excessive soil wetness and strong winds; and *severe*, that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

The *potential productivity* of merchantable or *important 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. Important 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

C.W. LIEZERT, civil engineer, Soil Conservation Service, helped to prepare this section.

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 sanitary 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, and local roads and streets 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 very firm, dense soil layers, bedrock, or large stones. In addition, excavations are affected by slope of the soil and the probability of flooding. Ratings do not apply to soil horizons below a depth of 6 feet unless otherwise noted.

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

Dwellings and *small commercial buildings* referred to in table 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, potential frost action, soil wetness, (fig. 9) and depth to a seasonal high water table were also considered (fig. 10). 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 (fig. 11).

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

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

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

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

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons have a nearly level floor and cut slopes or embankments of compacted soil material. Aerobic lagoons generally are designed to hold sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water. Soils that are very high in content of organic matter and those that have cobbles, stones, or boulders are not suitable. Unless the soil has very slow permeability, contamination of ground water is a hazard where the seasonal high water table is above the level of the lagoon floor. In soils where the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce the lagoon's capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the suitability of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soil material affect the performance of embankments.

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

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

Unless otherwise stated, the limitations in table 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, low potential frost action, 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.

Drainage of soil (fig. 12) 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.

Irrigation is affected by such features as slope, susceptibility to flooding, hazards of water erosion and soil blowing, texture, presence of salts and alkali, depth of root zone, rate of water intake at the surface, permeability of the soil below the surface layer, available water capacity, need for drainage, and depth to the water table.

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

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

Recreation

The soils of the survey area are rated in table 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, (fig. 13) 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 should 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 should 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, ragweed, smartweed, and panicgrass.

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

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 duckweed, wild millet, wildrice, willows, and cordgrass 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, slope, and permeability. The availability of a dependable water supply is important if water areas are to be developed. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

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

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

Woodland habitat consists of areas of hardwoods or conifers, or a mixture of both, and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include 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 can identify several important soil properties. They note the seasonal soil moisture condition or the presence of free water and its depth. For each horizon in the profile, they note the thickness and color of the soil material; the texture, or amount of clay, silt, sand, and gravel or other coarse fragments; the structure, or the natural pattern of cracks and pores in the undisturbed soil; and the consistence of the soil material in place under the existing soil moisture conditions. They record the depth of plant roots, determine the pH or reaction of the soil, and identify any free carbonates.

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

The available field and laboratory data are summarized in tables. The tables give the estimated range of engineering properties, the engineering classifications, and the physical and chemical properties of each major horizon of each soil in the survey area. They also present data about pertinent soil and water features 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 (Unified) (*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 AASHTO classification for soils tested in the survey area, with group index numbers in parentheses, is given in table 17. 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. Range in liquid limit and plasticity index are estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

In some surveys, the estimates are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg 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.

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

Soil 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.

Test data

This section discusses the physical and chemical analyses that have been made on soils in Crawford County, and it indicates where these data can be obtained. This section also shows engineering test data of some soils in the county.

Physical and chemical analyses

The Agronomy Department, Ohio Agricultural Research and Development Center (OARDC), Columbus, made laboratory tests on typical soils for ten series in Crawford County. The resulting data for particle size distribution, reaction, organic-matter content, calcium carbonate equivalent, and extractable cations were used in the classification and corrrelation of these soils and in the evaluation of their behavior under various land uses. The series and laboratory identification numbers of the soils are as follows: Bennington (CR-21), Bono (CR-15), Carlisle (CR-31), Condit (CR-20), Jimtown (CR-29), Lenawee (CR-17), Luray (CR-32), Lykens (CR-27), Pewamo (CR-28), and Tiro (CR-26).

In addition to laboratory data from Crawford County, other data from nearby counties that have many of the same soils are available. These data are on file in Columbus at the Agronomy Department, OARDC; the Ohio Department of Natural Resources, Divisions of Lands and Soil; and the Soil Conservation Service, State Office. The Agronomy Department, OARDC, also has data on clay mineralogy for soils in this survey.

Clay mineralogy was determined on pedons representing nine soil series in Crawford County. These studies showed that illite is the dominant clay mineral. In soils that formed in glacial till, illite make up about 45 to 70 percent of the clay in the B horizon and 75 to 85 percent of the clay in the C horizon and Vermiculite, kaolinite, quartz, and expanding clays make up lesser amounts of these horizons. In soils that formed in lacustrine deposits, about 30 to 60 percent of the clay is illite, 10 to 20 percent is vermiculite, 0 to 40 percent is expanding clays, 5 to 15 percent is quartz, and 0 to 5 percent is kaolinite.

Clay mineral studies also verified the presence of an argillic horizon in most soils on uplands and terraces. This horizon, however, was very weakly expressed in some of the very poorly drained soils.

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 Cardington (CR-19), Luray (CR-32), Pewamo (CR-28), and Tiro (CR-26) samples were analyzed by the Soil Physical Studies Laboratory, Ohio State University, Ohio Agricultural Research and Development Center. The coarse fragments greater than 2.0 millimeters in diameter were not included in the testing. However, these soil series commonly contain less than 10 percent coarse fragments, and their deletion does not significantly affect the engineering classification.

The Bennington (CR-21), Condit (CR-20), and Lykens (CR-27) samples, and the moisture density in the Pewamo (CR-28) 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 (*2*). The code for Unified classification is that assigned by the American Society for Testing and Materials (*3*).

The methods and codes are AASHTO classification (M-145-66); Unified classification (D-2487-69); mechanical analysis (T8) liquid limit (T89-60); plasticity index (T90-56); 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 (*14*). 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."

Alexandria series

The Alexandria series consists of well drained soils that have moderate permeability. These soils formed in calcareous glacial till that is medium in lime content. They occupy moraines and kames. Slopes range from 2 to 50 percent.

Alexandria soils are members of a drainage sequence that includes the moderately well drained Cardington soils, the somewhat poorly drained Bennington soils, the poorly drained Condit soils, and the very poorly drained Marengo and Pewamo soils. Alexandria soils are on positions in the landscape similar to those of Hennepin soils. They have an argillic horizon that Hennepin soils do not have. They also have a deeper solum than Hennepin soils.

The Alexandria soils in this county are in the fine-loamy family and are outside the range defined for the series. This difference, however, does not alter the use or behavior of the soils.

Typical pedon in an area of Alexandria silt loam, 6 to 12 percent slopes, moderately eroded, in Auburn Township, 200 feet south of State Route 98 and 1,200 feet west of State Route 598, SW1/4SE1/4 sec. 22, T. 22 N., R. 20 W.:

Ap—0 to 9 inches; dark brown (10YR 4/3) silt loam; moderate fine and medium granular structure; friable; many roots; 2 percent pebbles; slightly acid; clear smooth boundary.

B1t—9 to 14 inches; dark brown (7.5YR 4/4) loam; moderate fine and medium subangular blocky structure; friable; common roots; dark brown (10YR 4/3) organic coatings on faces of peds; medium continuous dark brown (10YR 3/3) clay films on faces of peds; 2 percent pebbles; medium acid; clear smooth boundary.

B21t—14 to 22 inches; dark brown (7.5YR 4/4) loam; few fine distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; common roots; thin continuous dark brown (7.5YR 3/2) clay films on faces of peds; 10 percent pebbles; medium acid; gradual smooth boundary.

B22t—22 to 30 inches; dark yellowish brown (10YR 4/4) gravelly clay loam; moderate medium and coarse subangular blocky structure; friable; few roots; thin continuous dark brown (7.5YR 3/2) clay films on faces of peds; 15 percent pebbles; medium acid; clear smooth boundary.

B3—30 to 36 inches; dark yellowish brown (10YR 4/4) gravelly clay loam; few fine distinct yellowish red (5YR 5/6) and strong brown (7.5YR 5/6) and many medium distinct grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; friable; few roots; thin continuous dark brown (10YR 4/3) clay films on faces of peds; 15 percent pebbles; neutral; abrupt smooth boundary.

C1—36 to 60 inches; dark brown (10YR 4/3) loam; few medium distinct grayish brown (10YR 5/2) and yellowish red (5YR 5/8) mottles; massive; friable; 10 percent pebbles; slight effervescence; mildly alkaline; clear smooth boundary.

C2—60 to 80 inches; dark brown (10YR 4/3) silt loam; few medium distinct grayish brown (10YR 5/2) and yellowish red (5YR 5/8) mottles; massive; firm; 2 percent pebbles; slight effervescence; mildly alkaline.

Solum thickness ranges from 26 to 46 inches. Coarse fragment content ranges from 2 to 15 percent throughout the solum.

The A1 horizon is very dark grayish brown (10YR 3/2) and is 2 to 4 inches thick. The Ap horizon is dark grayish brown (10YR 4/2), dark brown (10YR 4/3), or yellowish brown (10YR 5/4). A brown (10YR 5/3) A2 horizon as much as 4 inches thick is in some pedons.

In the B2t horizon, hue is 10YR or 7.5YR, value is 4 or 5, and chroma is 3 to 6. Texture is mainly loam or clay loam, but a subhorizon can be silt loam or silty clay loam in some pedons. The average clay content of the upper 20 inches of the B2t horizon is about 25 to 35 percent, although individual subhorizons can have clay content that ranges from 20 to 40 percent. Reaction is medium acid to very strongly acid in the upper part of this horizon and grades to neutral or mildly alkaline as depth increases.

The C horizon is calcareous. It is loam, silt loam, or clay loam glacial till.

Bennington series

The Bennington series consists of somewhat poorly drained soils that have moderately slow or slow permeability. In most areas, these soils formed in calcareous glacial till that is medium in lime content. In some areas, they formed in the till and a thin mantle of loess. They are on ground moraines and end moraines. Slopes range from 0 to 6 percent.

Bennington soils are members of a drainage sequence that includes the well drained Alexandria soils, the moderately well drained Cardington soils, the poorly drained Condit soils, and the very poorly drained Marengo and Pewamo soils. Bennington soils are on positions in the landscape similar to those of Blount, Wadsworth, and Elliott soils. They have slightly less clay in the B horizon and less calcium carbonate in the C horizon than Blount soils. They do not have a mollic epipedon, which Elliott soils have, or a fragipan, which Wadsworth soils have.

Typical pedon in an area of Bennington silt loam, 0 to 2 percent slopes, in Jefferson Township, 1,650 feet north of U.S. Route 30 and 300 feet west of a farm lane, NE1/4NE1/4 sec. 1, T. 16 N., R. 21 W.:

Ap—0 to 8 inches; dark grayish brown (2.5Y 4/2) silt loam; moderate very fine granular structure; friable; many roots; common fine black concretions; 1 percent pebbles; strongly acid; abrupt smooth boundary.

B&A—8 to 14 inches; yellowish brown (10YR 5/4) silty clay loam (B2t); common medium faint yellowish brown (10YR 5/6) mottles; strong fine and medium subangular blocky structure; friable; many roots; thick continuous grayish brown (10YR 5/2 and 2.5Y 5/2) silt coatings (A2) on faces of peds; thin very patchy grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) clay films in pores; 1 percent pebbles; very strongly acid; clear smooth boundary.

B21t—14 to 21 inches; yellowish brown (10YR 5/4) light silty clay; many medium prominent olive gray (5Y 5/2) mottles; strong medium prismatic structure parting to moderate medium subangular blocky; firm; common roots; common black (10YR 2/1) stains; medium continuous grayish brown (2.5Y 5/2) clay films along vertical faces of peds; 1 percent pebbles; medium acid; gradual smooth boundary.

B22t—21 to 30 inches; yellowish brown (10YR 5/6) silty clay loam; many medium prominent olive gray (5Y 5/2) mottles; moderate coarse prismatic structure parting to moderate medium subangular blocky; firm; common roots; medium continuous grayish brown (2.5Y 5/2) and gray (10YR 5/1) clay films along vertical faces of peds; few dark stains; 2 percent pebbles; mildly alkaline; clear smooth boundary.

B3t—30 to 42 inches; dark brown (10YR 4/3) silty clay loam; common medium distinct gray (10YR 5/1) and yellowish brown (10YR 5/4) mottles; moderate coarse prismatic structure; firm; few roots; thick continuous gray (10YR 5/1) and yellowish brown (10YR 5/4) clay films along vertical faces of peds; 2 percent pebbles; slight effervescence; mildly alkaline; clear smooth boundary.

C1—42 to 54 inches; dark grayish brown (10YR 4/2) clay loam; common coarse distinct yellowish brown (10YR 5/4) mottles; massive; very firm; gray (10YR 5/1) and grayish brown (10YR 5/2) silt coatings along vertical fractures; 5 percent black shale and sandstone fragments; slight effervescence; moderately alkaline; clear smooth boundary.

C2—54 to 64 inches; dark grayish brown (10YR 4/2) clay loam; common coarse distinct yellowish brown (10YR 5/4) mottles; massive; very firm; gray (10YR 5/1) and grayish brown (10YR 5/2) coatings on vertical fractures; 10 percent black shale and sandstone fragments; slight effervescence; moderately alkaline.

Solum thickness ranges from 28 to 50 inches. Where a silt mantle is present, the upper part of the solum has no pebbles or coarse fragments. The part of the solum that formed in till has 1 to 10 percent coarse fragments, mainly black shale flakes, sandstone, and a few crystalline and limestone pebbles.

The Ap horizon is dark grayish brown (2.5Y 4/2) or (10YR 4/2) or dark gray (10YR 4/1). Texture is silt loam or loam. The A1 horizon is silt loam 2 to 3 inches thick. Hue is 10YR, value is 2 to 4, and chroma is 1 or 2. An A2 horizon, when present, is typically grayish brown (10YR 5/2 or 2.5Y 5/2) silt loam 3 to 4 inches thick. Reaction in the A horizon ranges from strongly acid to neutral.

The B2t horizon is silty clay loam, clay loam, or light silty clay. Weighted average clay content is 35 to 40 percent, although clay content in an individual subhorizon can range from 30 to 44 percent. Hue is 10YR or 2.5Y, value is 4 or 5, and chroma is 3 to 6. Mottles that have chroma of 2 or less are present. Reaction ranges from very strongly acid in the upper part to mildly alkaline in the lower part.

In the C horizon, hue is 7.5YR to 2.5Y, value is 4 or 5, and chroma is 1 to 4. Secondary deposits of calcium carbonate are in the upper several inches of this horizon, but they disappear as depth increases. Texture is predominantly clay loam, but in places it is silt loam, loam, and silty clay loam. Unoxidized dark gray (N 4/0 and 10YR 4/1) till lies at a depth of 6 to 10 feet.

Blount series

The Blount series consists of somewhat poorly drained soils that have slow or moderately slow permeability. These soils are on uplands. In most places they formed in calcareous glacial till, but in some areas they formed in the till and a thin mantle of loess. Slopes range from 0 to 6 percent.

Blount soils are members of a drainage sequence that includes the moderately well drained Glynwood soils and the very poorly drained Pewamo soils. Blount soils are on positions in the landscape similar to those of Bennington, Wadsworth, and Elliott soils. They have slightly more clay in the B horizon and a higher content of calcium carbonate in the C horizon than Bennington soils. They do not have a mollic epipedon, which Elliott soils have. They do not have a fragipan, which Wadsworth soils have.

Typical pedon in an area of Blount silt loam, 0 to 2 percent slopes, in Tod Township about 550 feet north and 2,200 feet east of the southwest corner of sec. 13, T. 3 S., R. 15 E.:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; weak fine granular structure; friable; many fine pores; slightly acid; abrupt smooth boundary.

B&A—8 to 11 inches; brown (10YR 5/3) silty clay loam (B2t); many fine distinct yellowish brown (10YR 5/6) and light gray (10YR 6/1) mottles; moderate medium subangular and angular blocky structure; firm; common roots; thin patchy pale brown (10YR 6/3) silt coatings (A2) and thin patchy brown (10YR 5/3) clay films along vertical faces of peds; medium acid; abrupt smooth boundary.

B21t—11 to 16 inches; yellowish brown (10YR 5/4) silty clay; many medium faint gray (10YR 5/1) mottles; weak medium prismatic structure parting to moderate medium angular and subangular blocky; firm; common roots; medium continuous dark grayish brown (10YR 4/2) clay films along horizontal and vertical faces of peds; common black (10YR 2/1) concretions; medium acid; clear smooth boundary.

B22t—16 to 22 inches; dark yellowish brown (10YR 4/4) clay loam; common fine distinct light gray (10YR 6/1) mottles; moderate coarse and medium prismatic structure parting to moderate medium angular and subangular blocky; firm; many roots; medium patchy dark grayish brown (10YR 4/2) clay films along horizontal and vertical faces of peds; mildly alkaline; gradual smooth boundary.

B3—22 to 30 inches; dark yellowish brown (10YR 4/4) clay loam; yellowish brown (10YR 5/4) mottles; weak coarse prismatic structure; firm; many roots; thin patchy dark grayish brown (10YR 4/2) clay films on vertical faces of peds; light gray (10YR 6/1) lime coatings; 3 percent pebbles; strong effervescence; mildly alkaline; clear wavy boundary.

C—30 to 66 inches; yellowish brown (10YR 5/4) clay loam; common medium distinct dark grayish brown (10YR 4/2) mottles; weak thick platy structure; firm; light gray (10YR 6/1) lime coatings; 3 percent pebbles; strong effervescence; mildly alkaline.

Solum thickness ranges from 20 to 36 inches. A silt mantle, as much as 20 inches thick, is in some pedons. Where it is present, the upper part of the solum has no pebbles. The part of the solum that formed in glacial till contains 2 to 10 percent black shale, dolomite, limestone, sandstone, and crystalline pebbles.

The Ap horizon is dark grayish brown (10YR 4/2) or dark gray (10YR 4/1). The A1 horizon is 2 to 3 inches thick. Hue is 10YR, value is 2 or 3, and chroma is 1 or 2. An A2 horizon, 3 to 4 inches thick, is in some wooded areas. Reaction ranges from strongly acid to neutral.

The B1 or B&A horizon is 3 to 5 inches thick. The B2t horizon is silty clay loam, silty clay, clay loam, or light clay. Weighted average clay content is 35 to 40 percent, although clay content in an individual subhorizon can range from 30 to 45 percent. Hue is 10YR, value is 4 or 5, and chroma is 2 to 4. Reaction ranges from very strongly acid in the upper part of the B2t horizon to mildly alkaline in the lower part.

The C horizon is silty clay loam or clay loam.

Bogart series

The Bogart series consists of moderately well drained soils that have moderate permeability. These soils formed in loamy and gravelly glacial outwash. They are on outwash plains, terraces, and end moraines. Slopes range from 0 to 6 percent.

Bogart soils are members of a drainage sequence that includes the well drained Chili soils, the somewhat poorly drained Jimtown soils, and the very poorly drained Olmstead soils. Bogart soils are similar to Tuscola and Wilmer Variant soils. They have more coarse fragments in the solum and are more acid than Tuscola soils. They do not have a mollic epipedon, which Wilmer Variant soils have.

Typical pedon in an area of Bogart loam, 0 to 2 percent slopes, in Auburn Township, about 1,200 feet north of Sawyer Road and 3,400 feet west of Baker Road, SW1/4SW1/4 sec. 21, T. 22 N., R. 20 W.:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam; weak fine and medium granular structure; friable; very strongly acid; abrupt smooth boundary.

B1—8 to 13 inches; yellowish brown (10YR 5/4) loam; weak medium subangular blocky structure; friable; brown (10YR 5/3) silt coatings; thin very patchy clay films; 10 percent pebbles; very strongly acid; clear smooth boundary.

B21t—13 to 17 inches; dark yellowish brown (10YR 4/4) loam; few fine faint brown (10YR 4/3 and 5/3) mottles; moderate medium subangular blocky structure; friable; medium patchy clay films; 10 percent pebbles; strongly acid; gradual smooth boundary.

B22t—17 to 25 inches; dark yellowish brown (10YR 4/4) sandy clay loam; common medium faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; common brown (10YR 5/3) coatings on faces of peds; medium patchy clay films; 15 percent pebbles; strongly acid; gradual smooth boundary.

B23t—25 to 35 inches; yellowish brown (10YR 5/4) loam; common medium faint grayish brown (10YR 5/2) and brown (7.5YR 4/4) and few medium faint yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; few black (10YR 2/1) concretions; thin patchy dark yellowish brown (10YR 4/4) clay films; 12 percent pebbles; medium acid; clear smooth boundary.

IIB24tg—35 to 45 inches; grayish brown (10YR 5/2) sandy loam; common coarse distinct brown (7.5YR 4/4) and few medium distinct yellowish brown (10YR 5/4) mottles; weak coarse subangular blocky structure; friable; thin very patchy clay films; 5 percent pebbles; medium acid; gradual smooth boundary.

IIB3tg—45 to 59 inches; grayish brown (10YR 5/2) sandy loam; common coarse distinct brown (10YR 4/3) mottles; weak coarse subangular blocky structure; friable; 5 percent pebbles; thin very patchy clay films; slightly acid; abrupt smooth boundary.

IIC—59 to 75 inches; dark grayish brown (10YR 4/2) loamy fine sand; common medium distinct gray (10YR 5/1) and brown (10YR 4/3) mottles; single grained; loose; 10 percent pebbles; mildly alkaline.

Solum thickness is 40 to 60 inches.

The Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3). The A1 horizon is very dark grayish brown (10YR 3/2) and is 2 to 4 inches thick. An A2 horizon is in some pedons. It is typically brown (10YR 5/3) or pale brown (10YR 6/3).

The B2t horizon is loam, gravelly loam, gravelly clay loam, sandy loam, and sandy clay loam. Average clay content is 20 to 27 percent. Coarse fragment content ranges from 5 to 25 percent. Hue is 10YR, value is 4 or 5, and chroma is 2 to 4. Reaction in the B horizon is very strongly acid to slightly acid.

The C horizon is highly stratified. Texture is variable. Texture of individual stratum can be gravelly sandy loam, gravelly loam, or loamy fine sand. The coarse fragment content ranges from 10 to 30 percent. Reaction is strongly acid to mildly alkaline.

Bono series

The Bono series consists of very poorly drained soils that have slow permeability. These soils formed in calcareous lacustrine sediment that is high in silt content. They are in local depressions and large lakebed basins. Slopes are 0 to 2 percent.

Bono soils are on positions in the landscape similar to those of Lenawee, Lenawee Variant, Luray, and Sebring soils. Sloan soils are on nearby flood plains. Bono soils have a mollic epipedon, which Lenawee, Lenawee Variant, and Sebring soils do not have. They have more clay in the subsoil than Luray, Sebring, and Sloan soils. Bono soils do not have the irregular decrease in content of organic matter as depth increases, which Sloan soils have.

Typical pedon in an area of Bono silty clay loam, in Bucyrus Township, about 900 feet south of Monnett-Chapel Road and 1,050 feet east of State Route 98, NW1/4SW1/4 sec. 36, T. 3 S., R. 16 E.:

Ap—0 to 11 inches; black (10YR 2/1) silty clay loam; moderate medium and fine subangular blocky structure; firm; many roots; slightly acid; clear wavy boundary.

B1g—11 to 18 inches; dark gray (10YR 4/1) silty clay; many medium distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium angular blocky; firm; many fine roots; continuous gray (10YR 5/1) and very dark gray (10YR 3/1) coatings; neutral; gradual irregular boundary.

B21g—18 to 30 inches; gray (10YR 6/1) silty clay; many medium distinct brownish yellow (10YR 6/6) mottles; moderate coarse prismatic structure parting to weak coarse subangular blocky; firm; common fine roots; continuous gray (10YR 5/1) to very dark gray (10YR 3/1) coatings; large black (10YR 2/1) silty clay loam krotovinas, 3 to 4 inches in diameter, 10 percent by volume; neutral; diffuse smooth boundary.

B22g—30 to 39 inches; yellowish brown (10YR 5/6) silty clay loam; many coarse distinct gray (10YR 6/1) and faint light olive brown (2.5Y 5/4) mottles; weak coarse prismatic structure; gray (10YR 6/1) coatings; medium very patchy clay films; large krotovinas, 3 to 4 inches in diameter, 10 percent by volume; mildly alkaline; diffuse smooth boundary.

B31g—39 to 50 inches; brownish yellow (10YR 6/6) silty clay loam; many coarse prominent gray (N 5/0) mottles; weak coarse prismatic structure; firm; continuous thick gray (N 5/0) coatings; mildly alkaline; abrupt wavy boundary.

IIC1g—50 to 54 inches; gray (10YR 5/1) loam and 1/2-inch thick laminations of yellowish brown (10YR 5/8) silt and very fine sand; weak coarse prismatic structure parting to moderate medium platy; friable; common fine pores; gray (N 6/0) coatings; slight effervescence; mildly alkaline; abrupt wavy boundary.

IIIC2—54 to 70 inches; yellowish brown (10YR 5/4) clay loam; weak medium platy structure; firm; many gray (10YR 5/1) streaks along vertical fractures; 5 percent pebbles; slight effervescence; mildly alkaline.

Solum thickness and depth to free carbonates range from 30 to 60 inches.

In the mollic epipedon, hue is N (neutral) or 10YR, value is 2 or 3, and chroma is 0 to 2.

In the B2g horizon, hue is N, 10YR, or 5Y; value is 4 to 6; and chroma is 0 or 1. In some horizons below a depth of 20 inches, chroma is 3 to 6. Ped surfaces can have very dark organic coatings. Texture of the B2g horizon is silty clay, clay, or heavy silty clay loam. Reaction is neutral or slightly acid in the upper part of the B horizon and gradually increases to neutral or mildly alkaline in the lower part.

The C horizon is calcareous. It is laminated silt loam, loam, clay loam, and silty clay loam and has thin layers of very fine sand and silt. Reaction is mildly alkaline or moderately alkaline.

Cardington series

The Cardington series consists of moderately well drained soils that have moderately slow permeability. In most areas, these soils formed in calcareous glacial till that is medium in lime content. In some areas, they formed in the till and a thin mantle of loess. These soils are on end moraines and the dissected parts of ground moraines. Slopes range from 2 to 18 percent.

Cardington soils are members of a drainage sequence that includes the well drained Alexandria soils, the somewhat poorly drained Bennington soils, the poorly drained Condit soils, and the very poorly drained Marengo and Pewamo soils. Cardington soils are on positions in the landscape similar to those of Glynwood and Lykens soils. They formed in glacial till that has a lower calcium carbonate content than Glynwood soils. They have slightly less clay in the B horizon than Glynwood soils. Unlike Lyken soils, Cardington soils do not have silty glacial lake sediments in the upper part of the solum.

Typical pedon in an area of Cardington silt loam, 2 to 6 percent slopes, in Holmes Township, about 1,400 feet west and 1,300 feet south of the northeast corner sec. 1, T. 2 S., R. 16 E.:

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam; weak fine and medium granular structure; friable; many roots; neutral; abrupt smooth boundary.

B&A—7 to 10 inches; yellowish brown (10YR 5/4) silt loam (B2t); common medium faint brown (10YR 5/3) and yellowish brown (10YR 5/6) mottles; weak medium and thick platy structure parting to weak fine subangular blocky; friable; many roots; many pores; brown (10YR 5/3) silt coatings (A2) on faces of peds; dark grayish brown (10YR 4/2) fillings in worm channels; neutral; clear smooth boundary.

IIB21t—10 to 17 inches; yellowish brown (10YR 5/6) silty clay loam; few fine distinct grayish brown (2.5Y 5/2) mottles; moderate medium subangular blocky structure; firm; many roots; thin continuous brown (10YR 5/3) and dark brown (10YR 4/3) clay films on faces of peds; 2 percent pebbles; strongly acid; clear smooth boundary.

IIB22t—17 to 26 inches; yellowish brown (10YR 5/6) silty clay loam; common medium distinct dark brown (10YR 4/3) and gray (10YR 5/1) mottles; strong medium and coarse subangular blocky structure; firm; many roots; medium continuous grayish brown (10YR 5/2) clay films on vertical faces of peds; thin patchy dark brown (10YR 4/3) clay films on horizontal faces of peds; 2 percent pebbles; strongly acid; clear wavy boundary.

IIB3t—26 to 42 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate coarse prismatic structure parting to moderate thick platy; very firm; few roots; medium patchy dark grayish brown (10YR 4/2) clay films on horizontal and vertical faces of peds; many coarse very dark brown (10YR 2/2) concretions; 5 percent pebbles; slightly acid; clear wavy boundary.

IIC—42 to 68 inches; dark brown (10YR 4/3) silt loam; moderate thick platy structure; firm; few roots; yellowish brown (10YR 5/4) and gray (10YR 5/1) vertical streaks; 5 percent pebbles and black shale fragments; slight effervescence; mildly alkaline.

Solum thickness and depth to free carbonates range from 30 to 50 inches. Thickness of the silt mantle ranges from 0 to 20 inches. Where the silt mantle is present, the upper part of the solum has no coarse fragments. The part of the solum that formed in till has 2 to 10 percent coarse fragments, mainly black shale and sandstone and a few limestone and igneous rock.

In the Ap horizon, hue is 10YR, value is 4, and chroma is 2 or 3. In wooded areas, an A1 horizon, 2 to 3 inches thick, is present. In the A1 horizon, hue is 10YR, value is 2 to 4, and chroma is 1 or 2. This horizon overlies a brown A2 horizon that is 3 or 4 inches thick.

In the IIB2 horizon, hue is 10YR or 7.5YR, value is 4 or 5, and chroma is 3 to 6. Texture is mainly silty clay loam but is clay loam in some pedons. The horizon also has thin layers of clay or silty clay. Average clay content is 35 to 40 percent. Reaction is medium acid to very strongly acid in the B2 horizon. The acidity decreases in the B3 horizon as depth increases.

In the C horizon, hue is 10YR or 2.5Y, value is 4 or 5, and chroma is 2 to 4. Texture is clay loam, silt loam, silty clay loam, or loam. Reaction is mildly alkaline or moderately alkaline.

Carlisle series

The Carlisle series consists of very poorly drained, organic soils that have moderately rapid permeability. These soils formed in organic deposits from grasses, sedges, reeds, and woody material. They are in bogs on lake plains and till plains. Slopes range from 0 to 2 percent.

Carlisle soils are on positions in the landscape similar to those of Muskego, Olentangy, and Wallkill soils. Carlisle soils have more than 51 inches of sapric material on the surface, which Muskego and Olentangy soils do not have. They do not have a mineral surface layer, which Wallkill soils have.

Typical pedon in an area of Carlisle muck, in Polk Township, about 700 feet west and 400 feet south of the center of sec. 30, T. 20 N., R. 20 W.:

Oa1—0 to 7 inches; black (N 2/0) sapric material; 5 percent fiber, none rubbed; moderate medium granular structure; very friable; strongly acid; clear smooth boundary.

Oa2—7 to 21 inches; very dark brown (10YR 2/2) sapric material; 15 percent fiber, 2 percent rubbed; weak medium subangular blocky structure; friable; common woody fragments; strongly acid; clear wavy boundary.

Oa3—21 to 34 inches; dark brown (7.5YR 3/2) broken face, dark reddish brown (5YR 3/2) unrubbed, very dark brown (10YR 2/2) rubbed sapric material; 20 percent fiber, 5 percent rubbed; weak very thick platy structure; common woody fragments; strongly acid; gradual smooth boundary.

Oa4—34 to 60 inches; dark brown (7.5YR 3/2) broken face, very dark brown (10YR 2/2) rubbed sapric material; 25 percent fine herbaceous fiber, 5 percent rubbed; weak very thick platy structure; friable; medium acid.

The thickness of organic material is commonly more than 60 inches, but in some areas, mineral or coprogenous material is as shallow as 51 inches. Reaction in the subsurface tier is mainly medium acid or strongly acid but ranges to mildly alkaline. The surface and subsurface tiers are sapric material. In this material, hue is 10YR, 7.5YR, or N; value is 2 or 3; and chroma is 0 to 3. Fiber content in the subsurface tier is 5 to 30 percent before rubbing and less than 10 percent after rubbing. Wood fragments are common. The surface tier contains 30 to 50 percent mineral soil, and the subsurface tier contains 10 to 20 percent. The bottom tier is predominantly sapric material, but thin layers of less decomposed, or hemic, material are in some areas. Limnic materials, both mineral and coprogenous, are below 60 inches in some areas.

Chili series

The Chili series consists of well drained soils that have moderately rapid permeability. These soils formed in glacial outwash. They are on terraces, kames, and deltas. Slopes range from 0 to 18 percent.

Chili soils are members of a drainage sequence that includes the moderately well drained Bogart soils, the somewhat poorly drained Jimtown soils, and the very poorly drained Olmsted soils. Chili soils are on positions in the landscape similar to those of Gallman soils. They are more acid in the lower part of the solum than Gallman soils.

Typical pedon in an area of Chili loam, 2 to 6 percent slopes, in Dallas Township, about 1,500 feet south and 300 feet west of the northeast corner of sec. 7, T. 4 S., R. 16 E.:

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) loam; moderate fine granular structure; friable; many roots; 3 percent pebbles; slightly acid; abrupt smooth boundary.

A2—5 to 8 inches; brown (7.5YR 5/4) loam; moderate thin platy structure; friable; common roots; 3 percent pebbles; slightly acid; clear smooth boundary.

B1—8 to 14 inches; dark brown (7.5YR 4/4) loam; moderate medium subangular blocky structure; friable; common roots; brown (7.5YR 5/4) and pale brown (10YR 6/3) ped coatings; 5 percent pebbles; medium acid; clear wavy boundary.

B21t—14 to 30 inches; dark brown (7.5YR 4/4) gravelly clay loam; moderate medium subangular blocky structure; firm; few roots; pale brown (10YR 6/3) patchy silt coatings on vertical faces of peds in the upper few inches; clay bridging on sand and gravel; 15 percent pebbles; very strongly acid; clear wavy boundary.

B22t—30 to 43 inches; brown (7.5YR 5/4) sandy loam; weak coarse subangular blocky structure; friable; few roots; some clay bridging between sand grains; 10 percent pebbles; strongly acid; clear smooth boundary.

C—43 to 60 inches; yellowish brown (10YR 5/4) stratified fine sandy loam and gravelly loam; common grayish brown (10YR 5/2) streaks; massive; friable; 5 to 15 percent pebbles; slightly acid.

Solum thickness ranges from 40 to 60 inches. Reaction in the solum is very strongly acid to slightly acid. Reaction in the C horizon is mainly slightly acid or neutral, but calcareous material is within a depth of 60 inches in some pedons.

The Ap horizon is dark brown (10YR 4/3), dark grayish brown (10YR 4/2), or brown (10YR 5/3). The A1 horizon is 1 to 5 inches thick and is very dark grayish brown (10YR 3/2) or very dark brown (10YR 2/2). An A2 horizon, as much as 7 inches thick, is present in uncultivated areas. It is brown (10YR 5/3 and 7.5YR 5/4) or pale brown (10YR 6/3).

In the B2t horizon, hue is 7.5YR or 10YR, value is 4 or 5, and chroma is 3 or 4. Texture is gravelly loam, gravelly clay loam, loam, sandy clay loam, clay loam, gravelly sandy clay loam, and sandy loam. The average clay content of the upper 20 inches of the B2t horizon is 18 to 30 percent, but the clay content in individual horizons can be 15 to 35 percent. The coarse fragment content ranges from 5 to 35 percent.

The C horizon is stratified. Texture is sandy loam, gravelly loam, loamy sand, and gravelly loamy sand. The coarse fragment content ranges from 5 to 40 percent. The C horizon is brown or yellowish brown.

Colwood series

The Colwood series consists of very poorly drained soils that have moderate permeability. These soils formed in calcareous water-deposited material. They are in slight depressions along the margin of glacial lake plains.

Colwood soils are members of a drainage sequence that includes the moderately well drained Tuscola soils and the somewhat poorly drained Kibbie soils. Colwood soils are on positions in the landscape similar to those of Olmstead soils. They have less gravel in the solum than Olmstead soils.

Typical pedon in an area of Colwood silt loam, in Whetstone Township, about 500 feet north and 800 feet west of the southeast corner of sec. 35, T. 3 S., R. 17 E.:

Ap—0 to 8 inches; very dark gray (10YR 3/1) silt loam; weak medium granular structure; friable; slightly acid; clear smooth boundary.

A12—8 to 13 inches; very dark gray (10YR 3/1) silt loam; moderate medium subangular blocky structure; friable; slightly acid; gradual smooth boundary.

B21g—13 to 19 inches; gray (10YR 5/1) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; thin continuous dark gray (10YR 4/1) silt coatings on horizontal and vertical faces of peds; slightly acid; clear smooth boundary.

IIB22g—19 to 33 inches; gray (10YR 5/1) clay loam; common fine distinct yellowish brown (10YR 5/6), few medium prominent yellowish red (5YR 5/8), and few medium faint brown (10YR 5/3) mottles; moderate medium prismatic structure parting to weak medium subangular blocky; firm; mildly alkaline; clear smooth boundary.

IIB3g—33 to 41 inches; grayish brown (10YR 5/2) fine sandy loam; common fine distinct yellowish brown (10YR 5/6) and common fine faint gray (10YR 5/1) mottles; weak coarse prismatic structure; loose; 3 percent pebbles; mildly alkaline; clear smooth boundary.

IIIC1g—41 to 67 inches; gray (10YR 5/1) silty clay loam; common medium faint grayish brown (10YR 5/2) and common coarse distinct yellowish brown (10YR 5/4) mottles; massive; very firm; few thin lenses of silt and fine sand; slight effervescence; mildly alkaline; abrupt smooth boundary.

IVC2—67 to 70 inches; dark brown (10YR 4/3) loamy sand; few fine faint brown (10YR 5/3) and few fine distinct yellowish brown (10YR 5/6) mottles; single grained; loose; 3 percent black (10YR 2/1) shale fragments; slight effervescence; mildly alkaline.

Solum thickness ranges from 24 to 50 inches. Reaction ranges from slightly acid to mildly alkaline in the upper part of the solum and from neutral to moderately alkaline in the lower part.

In the A horizon, hue is 10YR, value is 2 or 3, and chroma is 1 or 2. Thickness ranges from 10 to 14 inches.

In the B horizon, hue is 10YR to 5Y, value is 4 to 6, and chroma is 1 or 2. Texture is mainly loam, clay loam, silty clay loam, fine sandy loam, and silt loam, but thin strata that have coarser or finer texture than these are in the lower part of the horizon. The thickness and vertical sequence of the strata varies within short distances.

In the C horizon, hue is 10YR, value is 4 to 6, and chroma is 1 to 3. Strata in the C horizon are sandy loam, silty clay loam, loamy sand, and fine sand.

Condit series

The Condit series consists of poorly drained soils that have slow permeability. These soils formed in calcareous glacial till that is medium in lime content. They are in low-lying areas and slight depressions on the till plain. Slopes are 0 to 2 percent.

Condit soils are members of a drainage sequence that includes the well drained Alexandria soils, the moderately well drained Cardington soils, the somewhat poorly drained Bennington soils, and the very poorly drained Marengo and Pewamo soils. Condit soils are on positions in the landscape similar to those of Marengo and Pewamo soils. They have more clay in the subsoil than Marengo soils. They have an ochric epipedon, which Marengo and Pewamo soils do not have.

Condit soils in Crawford County are mapped only in a complex with Bennington soils.

Typical pedon of Condit silt loam in an area of Condit-Bennington silt loams, in Jefferson Township, about 2,600 feet east and 1,500 feet south of the northwest corner of sec. 6, T. 20 N., R. 20 W.:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) rubbed; moderate fine subangular blocky structure; friable; many roots; neutral; abrupt smooth boundary.

B1tg—9 to 18 inches; dark gray (10YR 4/1) silty clay loam; many medium distinct yellowish brown (10YR 5/4) and grayish brown (2.5Y 5/2) mottles; moderate fine prismatic structure parting to moderate medium subangular blocky; firm; common roots; medium patchy very dark grayish brown (10YR 3/2) clay films; few fine distinct black (10YR 2/1) stains; medium acid; clear wavy boundary.

B21tg—18 to 30 inches; gray (10YR 5/1) silty clay loam; many coarse distinct yellowish brown (10YR 5/4) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; common roots; medium patchy dark grayish brown (10YR 4/2) clay films; medium acid; clear wavy boundary.

B22tg—30 to 42 inches; dark gray (N 4/0) silty clay loam; many coarse distinct yellowish brown (10YR 5/4) mottles; moderate coarse prismatic structure parting to moderate coarse subangular blocky; firm; few roots; medium patchy dark grayish brown (10YR 4/2) clay films; neutral; clear wavy boundary.

B3—42 to 52 inches; yellowish brown (10YR 5/4) silty clay loam; many medium distinct dark gray (10YR 4/1) and gray (10YR 5/1) mottles; weak coarse subangular blocky structure; firm; few roots; common sandstone and black shale fragments; mildly alkaline; abrupt irregular boundary.

C—52 to 70 inches; dark brown (10YR 4/3) silty clay loam; many medium faint yellowish brown (10YR 5/4) mottles; weak very coarse prismatic structure; very firm; common coarse distinct gray (N 5/0) streaks; common sandstone and black shale fragments; slight effervescence; moderately alkaline; gradual smooth boundary.

Solum thickness ranges from 40 to 55 inches. Reaction is medium acid to strongly acid in the upper part of the B horizon and grades to neutral or mildly alkaline in the lower part.

The Ap horizon is dark grayish brown (10YR 4/2) or dark gray (10YR 4/1). The A1 horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) and is 2 to 4 inches thick. An A2g horizon is in some pedons and is 2 to 6 inches thick. It is dark gray (10YR 4/1) or gray (10YR 5/1). The A horizon is mainly silt loam but in some pedons is silty clay loam.

The B2 horizon is silty clay loam, clay loam, or silty clay. Average clay content in the upper 20 inches of the B2t horizon is 35 to 40 percent, but the clay content in individual subhorizons can be 30 to 45 percent. In the B2t horizon, hue is 5Y to 10YR, value is 4 or 5, and chroma is 0 to 2. Mottles that have chroma of more than 2 are present. Below a depth of 30 inches, chroma is 3 or 4 in some profiles.

In the C horizon, hue is 10YR or 2.5Y, value is 4 or 5, and chroma is 2 to 4. Streaks of gray (10YR 5/1 or N 5/0) or dark gray (10YR 4/1) are along widely spaced vertical fractures. Texture of the C horizon is loam or silty clay loam. The content of coarse fragments of limestone, shale, and sandstone is 2 to 10 percent. Unoxidized dark gray (N 4/0 or 10YR 4/1) till lies at a depth of 6 to 10 feet.

Del Rey series

The Del Rey series consists of somewhat poorly drained soils that have slow permeability. These soils formed in calcareous lacustrine sediment that is high in silt content. They are on broad flats in former glacial lake basins. Slopes range from 0 to 2 percent.

Del Rey soils are on positions in the landscape similar to those of Fitchville soils. They have more clay in the subsoil than Fitchville soils.

Typical pedon in an area of Del Rey silt loam, 0 to 2 percent slopes, in Auburn Township, about 100 feet north and 900 feet west of the southeast corner of sec. 19, T. 22 N., R. 20 W.:

Ap1—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam; moderate medium granular structure; friable; few fine dark concretions; neutral; clear smooth boundary.

Ap2—6 to 10 inches; dark grayish brown (10YR 4/2) silt loam; weak medium subangular blocky structure; firm; neutral; abrupt smooth boundary.

B21t—10 to 20 inches; dark yellowish brown (10YR 4/4) silty clay loam; common fine distinct strong brown (7.5YR 5/6) and gray (10YR 5/1) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; thin patchy dark gray (10YR 4/1) clay films on faces of peds; medium continuous grayish brown (10YR 5/2) skeletans on vertical faces of peds; common dark grayish brown (10YR 4/2) silt loam krotovinas; slightly acid; clear smooth boundary.

B22tg—20 to 30 inches; gray (10YR 5/1) silty clay; few fine faint light gray (10YR 6/1) and common medium distinct yellowish brown (10YR 5/4 and 5/6) mottles; moderate coarse prismatic structure; firm; medium patchy dark gray (10YR 4/1) clay films on faces of peds; medium continuous grayish brown (10YR 5/2) skeletans on faces of peds; common dark grayish brown (10YR 4/2) silt loam krotovinas; neutral; clear smooth boundary.

B3g—30 to 46 inches; gray (10YR 5/1) silty clay loam; common medium distinct yellowish brown (10YR 5/4 and 5/6) mottles; weak coarse prismatic structure; firm; medium very patchy dark gray (10YR 4/1) clay films on vertical faces of peds; medium continuous grayish brown (10YR 5/2) skeletans on faces of peds; common dark grayish brown (10YR 4/2) silt loam krotovinas; slight effervescence; mildly alkaline; clear smooth boundary.

Cg—46 to 72 inches; grayish brown (10YR 5/2) silt loam; common medium distinct yellowish brown (10YR 5/4) mottles; weak medium platy structure; massive; firm; dark brown (10YR 4/3) sand layers that have gray (10YR 5/1) streaks along vertical cracks; slight effervescence; mildly alkaline.

Solum thickness ranges from 24 to 48 inches. Reaction ranges from strongly acid in the upper part of the solum to mildly alkaline or moderately alkaline in the lower part, unless the soil has been limed.

The Ap horizon is dark grayish brown (10YR 4/2) or dark gray (10YR 4/1). An A2 horizon is in some pedons.

In the B horizon, hue is 10YR or 2.5Y, value is 4 to 6, and chroma is 1 to 4. Texture is mainly silty clay loam or silty clay, but thin layers of silt loam or fine sandy loam are in the lower part of the B horizon in some pedons.

The C horizon is commonly laminated with silty clay loam and thin layers of fine sandy loam.

Elliott series

The Elliott series consists of somewhat poorly drained soils that have moderately slow permeability. Most of these soils formed in calcareous glacial till, but some formed in the till and a thin mantle of loess. These soils are on ground moraines and end moraines. Slopes range from 0 to 3 percent.

Elliott soils are on positions in the landscape similar to those of Bennington and Blount soils. They have a mollic epipedon, which Bennington and Blount soils do not have.

Typical pedon in an area of Elliott silt loam, 0 to 3 percent slopes, in Bucyrus Township, about 300 feet north and 300 feet west of the southeast corner of sec. 28, T. 3 S., R. 16 E.:

Ap—0 to 9 inches; very dark gray (10YR 3/1) silt loam, very dark grayish brown (10YR 3/2) rubbed; moderate medium granular structure; friable; neutral; abrupt smooth boundary.

A3—9 to 15 inches; very dark grayish brown (10YR 3/2) silty clay loam; many coarse faint dark grayish brown (10YR 4/2) and few fine distinct yellowish brown (10YR 5/6) mottles; moderate fine and medium subangular blocky structure; friable; neutral; clear wavy boundary.

B21t—15 to 21 inches; brown (10YR 4/3) silty clay loam; common fine distinct yellowish brown (10YR 5/6) and few fine distinct grayish brown (10YR 5/2) or gray (10YR 5/1) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; thin continuous clay films on faces of prisms and thin patchy clay films on faces of blocks; dark gray (10YR 4/1) coatings on faces of peds; 3 percent pebbles; neutral; clear wavy boundary.

B22t—21 to 30 inches; olive brown (2.5Y 5/6) clay loam; few medium distinct gray (10YR 5/1) mottles; weak medium subangular blocky structure; firm; gray (10YR 5/1) coatings; thin patchy clay films; 3 percent pebbles; mildly alkaline; gradual smooth boundary.

B3t—30 to 36 inches; olive brown (2.5Y 4/4) clay loam; common fine distinct gray (10YR 5/1), very dark gray (10YR 3/1), and yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; very firm; thin patchy clay films on faces of peds; 5 percent pebbles; slight effervescence; mildly alkaline; clear wavy boundary.

C—36 to 68 inches; olive brown (2.5Y 4/4) clay loam; common fine distinct gray (10YR 5/1), very dark gray (10YR 3/1), and yellowish brown (10YR 5/6) mottles; massive; very firm; 5 percent pebbles; slight effervescence; mildly alkaline.

Solum thickness ranges from 24 to 40 inches. Pebble content ranges from 0 to 5 percent in the upper part of the solum and from 2 to 10 percent in the lower part. Reaction is medium acid to neutral in the upper part and neutral or mildly alkaline in the lower part. The mollic epipedon is 10 to 16 inches thick.

In the Ap horizon, hue is 10YR, value is 2 or 3, and chroma is 1 or 2.

In the B horizon, hue is 2.5Y or 10YR, value is 4 to 6, and chroma is 3 or 4. Texture is silty clay loam, silty clay, or clay loam. Weighted average clay content in the upper 20 inches of the Bt horizon is 35 to 40 percent.

The C horizon is mottled clay loam or silty clay loam. Reaction is mildly alkaline or moderately alkaline.

Fitchville series

The Fitchville series consists of somewhat poorly drained soils that have moderately slow permeability. These soils formed in lacustrine sediment that is high in silt content. They are on rises in glacial lakebeds. Slopes range from 0 to 6 percent.

Fitchville soils are members of the drainage sequence that includes the poorly drained Sebring soils and the very poorly drained Luray soils. Fitchville soils are on positions in the landscape similar to those of Del Rey soils. They have less clay in the subsoil than Del Rey soils.

Typical pedon in an area of Fitchville silt loam, 0 to 2 percent slopes, in Whetstone Township, about 2,200 feet north and 500 feet west of the southeast corner of sec. 23, T. 3 S., R. 17 E.:

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam; weak medium granular structure; friable; neutral; abrupt smooth boundary.

B&A—7 to 12 inches; yellowish brown (10YR 5/4) silty clay loam (B2t); many fine faint grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; grayish brown (10YR 5/2) silt coatings (A2) on vertical faces of peds; strongly acid; clear smooth boundary.

B21tg—12 to 18 inches; grayish brown (10YR 5/2) silty clay loam; many fine distinct dark brown (10YR 4/3) and yellowish brown (10YR 5/6) mottles; moderate coarse subangular blocky structure; firm; thin very patchy clay films; medium acid; gradual wavy boundary.

B22tg—18 to 37 inches; light brownish gray (2.5Y 6/2) silty clay loam; many coarse distinct yellowish brown (10YR 5/4 and 5/6) mottles; weak coarse prismatic structure; firm; medium patchy clay films; slightly acid; gradual wavy boundary.

B3—37 to 54 inches; yellowish brown (10YR 5/4) silty clay loam; many coarse distinct gray (10YR 5/1) and many coarse faint yellowish brown (10YR 5/6) mottles; massive; friable; weakly stratified; common dark stains; slightly acid; clear smooth boundary.

IIC1—54 to 62 inches; yellowish brown (10YR 5/4) clay loam; many coarse distinct gray (10YR 5/1) and many coarse faint yellowish brown (10YR 5/6) mottles; massive; friable; stratified; neutral; abrupt smooth boundary.

IIC2—62 to 78 inches; brown (10YR 4/3) clay loam; many coarse distinct gray (N 5/0) and yellowish brown (10YR 5/4) mottles; massive; very firm; few light gray (10YR 7/2) lime coatings along vertical cracks; slight effervescence in lower part; mildly alkaline.

Solum thickness and depth to carbonates range from 40 to 70 inches. Reaction is medium acid to very strongly acid in the B1 horizon and upper part of the B2 horizon. It is slightly acid or neutral in the lower part of the B2 horizon and in the B3 horizon. The solum is essentially free of coarse fragments. A few pebbles or thin gravelly layers are in the underlying material.

The Ap horizon is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2).

In the B2 horizon, hue is 10YR or 2.5Y, value is 4 to 6, and chroma is 2 to 5. Texture is heavy silt loam or silty clay loam. Average clay content is typically between 25 and 32 percent but ranges from 22 to 35 percent. Individual subhorizons can have a clay content outside this range.

The C horizon is predominantly stratified silt loam, clay loam, and silty clay loam, but thin strata of loam or fine sandy loam are commonly present. In some pedons, clay loam glacial till is at a depth of 4 to 6 feet.

Gallman series

The Gallman series consists of well drained soils that have moderately rapid permeability. These soils formed in calcareous glacial outwash. They are on terraces. Slopes range from 0 to 6 percent.

Gallman soils are on positions in the landscape similar to those of Chili soils. They are less acid in the lower part of the solum than Chili soils.

Typical pedon in an area of Gallman silt loam, 2 to 6 percent slopes, in Jefferson Township, about 300 feet north of Lower Leesville Road and 700 feet west of Biddle Road, SE1/4SE1/4 sec. 2, T. 16 N., R. 21 W.:

Ap—0 to 11 inches; dark brown (10YR 4/3) silt loam; moderate fine granular structure; friable; slightly acid; abrupt smooth boundary.

B1—11 to 16 inches; yellowish brown (10YR 5/4) silt loam; weak medium subangular blocky structure; firm; dark brown (10YR 4/3) coatings on faces of peds; slightly acid; gradual smooth boundary.

B21t—16 to 21 inches; yellowish brown (10YR 5/4) heavy silt loam; moderate medium subangular blocky structure; firm; thin very patchy dark brown (10YR 4/3) clay films on vertical and horizontal faces of peds; slightly acid; gradual wavy boundary.

IIB22t—21 to 30 inches; yellowish brown (10YR 5/4) clay loam; moderate coarse subangular blocky structure; firm; medium patchy clay films on vertical and horizontal faces of peds; 3 percent pebbles; medium acid; gradual wavy boundary.

IIB23t—30 to 44 inches; yellowish brown (10YR 5/4) clay loam; common fine distinct grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to weak coarse subangular blocky; firm;

medium patchy brown (10YR 5/3) clay films on vertical and horizontal faces of peds; 3 percent pebbles; medium acid; clear wavy boundary.

IIIB31t—44 to 51 inches; dark yellowish brown (10YR 4/4) gravelly sandy clay loam; common fine distinct dark brown (7.5YR 4/2 and 4/4) mottles; weak coarse subangular blocky structure; firm; medium patchy clay films on vertical and horizontal faces of peds; 20 percent pebbles; strongly acid; clear wavy boundary.

IIIB32t—51 to 58 inches; yellowish brown (10YR 5/4) gravelly loam; weak coarse subangular blocky structure; firm; medium very patchy clay films on vertical and horizontal faces of peds; 25 percent pebbles; medium acid; clear wavy boundary.

IVB33—58 to 74 inches; light olive brown (2.5Y 5/4) clay loam; common fine faint yellowish brown (10YR 5/4) mottles; weak coarse prismatic structure; firm; 10 percent pebbles; mildly alkaline; clear wavy boundary.

IVC—74 to 80 inches; light olive brown (2.5Y 5/4) loam; massive; firm; 10 percent pebbles; slight effervescence; moderately alkaline.

Solum thickness ranges from 55 to 80 inches. The part of the upper solum that derived from silt mantle is 12 to 24 inches thick. Reaction in the upper part of the solum is very strongly acid to slightly acid, unless the soil has been limed, and medium acid to mildly alkaline in the lower part.

The Ap horizon is dark grayish brown (10YR 4/2) or dark brown (10YR 4/3). In the B horizon, hue is 10YR, 7.5YR, or 2.5Y; value is 4 or 5; and chroma is 3 or 4. Texture is clay loam, sandy clay loam, silt loam, and loam. Gravelly analogs of these textures are in the lower part of the B horizon. The lower part contains coarse fragments, mainly rounded sandstone, shale, and limestone.

The C horizon is mainly loam or clay loam but has thin layers of loamy sand and sandy loam. Gravel content is 5 to 20 percent. Reaction is neutral to moderately alkaline.

Glynwood series

The Glynwood series consists of moderately well drained soils that have slow permeability. These soils formed in calcareous glacial till. They are on the sides of stream valleys and small knolls and on ridges of end moraines. Slopes range from 2 to 18 percent.

Glynwood soils are members of a drainage sequence that includes the somewhat poorly drained Blount soils and the very poorly drained Pewamo soils. Glynwood soils are on positions in the landscape similar to those of Cardington and Lykens soils. They formed in glacial till that is higher in calcium carbonate content than the till in which Cardington soils formed. Glynwood soils do not have a silt mantle, which Lykens soils have.

Typical pedon in an area of Glynwood silt loam, 2 to 6 percent slopes, moderately eroded, in Dallas Township, about 960 feet north of Caldwell Road and 1,600 feet east of Marion-Melmore Road, S1/2SW1/4 sec. 25, T. 3 S., R. 15 E.:

Ap—0 to 8 inches; brown (10YR 4/3) silt loam; moderate fine granular structure; friable; neutral; abrupt smooth boundary.

B1—8 to 14 inches; yellowish brown (10YR 5/4) silty clay loam; common medium faint yellowish brown (10YR 5/6) mottles; strong medium subangular blocky structure; firm; thin very patchy brown (10YR 5/3) clay films and silt coatings on horizontal and vertical faces of peds; very strongly acid; clear smooth boundary.

B21t—14 to 19 inches; dark yellowish brown (10YR 4/4) silty clay; few fine distinct grayish brown (10YR 5/2) mottles; moderate medium and coarse subangular blocky structure; firm; medium patchy yellowish brown (10YR 5/4) clay films on horizontal and vertical faces of peds; very strongly acid; gradual smooth boundary.

B22t—19 to 26 inches; dark yellowish brown (10YR 4/4) clay loam; common fine faint yellowish brown (10YR 5/4) and common fine distinct light gray (10YR 6/1) mottles; weak medium prismatic structure parting to weak coarse subangular blocky; firm; medium patchy yellowish brown (10YR 5/4) clay films on horizontal and vertical faces of peds; 3 percent black (10YR 2/1) shale fragments; neutral; clear wavy boundary.

B3t—26 to 33 inches; brown (10YR 4/3) clay loam; common fine faint gray (10YR 5/1) and yellowish brown (10YR 5/4) mottles; weak coarse prismatic structure; firm; medium very patchy clay films on vertical faces of peds; 5 percent limestone and black shale pebbles; mildly alkaline; gradual wavy boundary.

C—33 to 60 inches; brown (10YR 4/3) clay loam; common fine distinct gray (10YR 5/1) and yellowish brown (10YR 5/4) and few fine distinct strong brown (7.5YR 5/8) mottles; massive; firm; 5 percent limestone and black shale pebbles; slight effervescence; moderately alkaline.

Solum thickness ranges from 25 to 36 inches. Reaction ranges from very strongly acid to neutral in the upper part of the solum and from slightly acid to moderately alkaline in the lower part. Coarse fragment content ranges from 0 to 5 percent in the upper part of the solum and from 1 to 10 percent in the lower part.

The Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3). The A1 horizon, where present, is 2 to 6 inches thick. In the A1 horizon, hue is 10YR, value is 2, and chroma is 1 or 2. A brown (10YR 5/3) A2 horizon is present in some pedons. It is 3 to 4 inches thick.

In the B2 horizon, hue is 7.5YR or 10YR, value is 4 or 5, and chroma is 3 or 4. Texture is silty clay loam, clay loam, silty clay, or clay. Weighted average clay content in the B2 horizon is 35 to 40 percent.

The C horizon is brown (10YR 4/3 and 5/3) and yellowish brown (10YR 5/4). Texture is clay loam or silty clay loam.

Hennepin series

The Hennepin series consists of well drained soils that have moderately slow permeability. These soils formed in calcareous glacial till. They are on valley sides on the uplands. Slopes range from 18 to 50 percent.

Hennepin soils are on positions in the landscape similar to those of Alexandria soils and are mapped in a complex with these soils. Hennepin soils have a thinner solum and do not have an argillic horizon, which Alexandria soils have.

Typical pedon of Hennepin silt loam in an area of Hennepin-Alexandria silt loams, 18 to 50 percent slopes, in Liberty Township, about 1,225 feet east and 100 feet south of the northwest corner of sec. 34, T. 2 S., R. 17 E.:

A1—0 to 3 inches; dark grayish brown (10YR 4/2) silt loam; moderate medium subangular blocky structure parting to weak medium granular; friable; many roots; neutral; clear smooth boundary.

B21—3 to 7 inches; brown (10YR 4/3) clay loam; weak medium prismatic structure parting to moderate medium subangular blocky; friable; common roots; common fine black shale fragments and few crystalline pebbles; mildly alkaline; gradual wavy boundary.

B22—7 to 14 inches; brown (10YR 4/3) clay loam; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; few roots; 5 percent pebbles; slight effervescence; mildly alkaline; clear wavy boundary.

C1—14 to 32 inches; brown (10YR 5/3) clay loam; few fine distinct yellowish brown (10YR 5/8) mottles; massive; very firm; common medium light gray (10YR 6/1) lime segregations; 5 percent pebbles; slight effervescence; mildly alkaline; gradual smooth boundary.

C2—32 to 60 inches; brown (10YR 4/3) light clay loam; massive; very firm; 5 percent pebbles; slight effervescence; mildly alkaline.

Solum thickness ranges from 10 to 20 inches. Reaction in the solum ranges from slightly acid to moderately alkaline.

The B horizon is loam, silt loam, and clay loam. In the B horizon, hue is 10YR, value is 4 or 5, and chroma is 3 or 4.

The C horizon is clay loam, silt loam, or loam. Content of coarse fragments ranges from 5 to 10 percent.

Jimtown series

The Jimtown series consists of somewhat poorly drained soils that have moderate permeability. These soils formed in loamy, sandy, and gravelly glacial outwash. They are on glacial outwash plains and melt water channels. Slopes range from 0 to 6 percent.

Jimtown soils are members of a drainage sequence that includes the well drained Chili soils, the moderately well drained Bogart soils, and the very poorly drained Olmsted soils. Jimtown soils are on positions in the landscape similar to those of Kibbie and Wilmer Variant soils. They have more coarse fragments in the solum than Kibbie soils. They do not have a mollic epipedon, which Wilmer Variant soils have.

Typical pedon in an area of Jimtown loam, 0 to 2 percent slopes, in Holmes Township, about 2,000 feet west and 200 feet north of the southeast corner of sec. 3, T. 2 S., R. 16 E.:

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) loam; moderate medium granular structure; friable; 5 percent pebbles; neutral; abrupt smooth boundary.

B1—9 to 13 inches; dark brown (10YR 4/3) loam; common medium distinct grayish brown (10YR 5/2) and many medium distinct yellowish brown (10YR 5/4 and 5/6) mottles; weak medium subangular blocky structure; friable; grayish brown (10YR 5/2) silt coatings on faces of peds; 5 percent pebbles; medium acid; gradual smooth boundary.

B21t—13 to 22 inches; dark brown (10YR 4/3) loam; many medium distinct grayish brown (10YR 5/2) and common medium distinct yellowish brown (10YR 5/4 and 5/6) mottles; weak coarse subangular blocky structure; firm; grayish brown (10YR 5/2) silt coatings on faces of peds; thin very patchy yellowish brown (10YR 5/4) clay films on vertical faces of peds; 5 percent pebbles; strongly acid; gradual smooth boundary.

B22t—22 to 28 inches; brown (10YR 5/3) sandy loam; common medium distinct gray (10YR 6/1), black (10YR 2/1), yellowish brown (10YR 5/6), and strong brown (7.5YR 5/6) mottles; weak coarse subangular blocky structure; friable; continuous gray (10YR 5/1) silt coatings on faces of peds; thin very patchy grayish brown (10YR 5/2) clay films on faces of peds and pebble surfaces; 10 percent pebbles; strongly acid; gradual smooth boundary.

B23t—28 to 42 inches; dark yellowish brown (10YR 4/4) sandy loam; common medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; friable; continuous gray (10YR 5/1) coatings on faces of peds; thin patchy grayish brown (10YR 5/2) clay films; 10 percent pebbles; strongly acid; gradual smooth boundary.

C1—42 to 60 inches; yellowish brown (10YR 5/4) stratified loam and sandy loam; common medium distinct gray (10YR 5/1) and common medium faint yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure; friable; 10 percent pebbles; medium acid; gradual smooth boundary.

C2—60 to 72 inches; yellowish brown (10YR 5/4) gravelly sandy loam; common medium distinct dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) mottles; massive; friable; 15 percent pebbles; medium acid; clear smooth boundary.

C3—72 to 84 inches; 50 percent gray (10YR 5/1) and 50 percent black (10YR 2/1) gravelly sandy loam; massive; friable; 25 percent pebbles; slight effervescence; mildly alkaline.

Solum thickness ranges from 30 to 48 inches. Reaction is very strongly acid to slightly acid in the solum, unless the soil has been limed, and strongly acid to moderately alkaline in the C horizon. Depth to free carbonates ranges from 36 to more than 60 inches.

The Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3).

In the B2 horizon, hue is 10YR, value is 4 or 5, and chroma is 2 to 4. Mottles that have chroma of 2 or less are present where matrix chroma is 3 or 4. Texture is loam, sandy loam, gravelly loam, gravelly clay loam, or gravelly sandy clay loam. Average clay content of the argillic horizon is 18 to 27 percent. The coarse fragment content is 5 to 25 percent.

The C horizon is stratified gravelly sandy loam, gravelly loam, loamy sand, and gravelly sand. Thin layers of clean gravel are in this horizon in some pedons. The total coarse fragment content of the C horizon ranges from 10 to 40 percent.

Kibbie series

The Kibbie series consists of somewhat poorly drained soils that have moderate permeability. These soils formed in calcareous water-deposited materials. They occupy margins of former glacial lakes. Slopes range from 0 to 6 percent.

Kibbie soils are members of a drainage sequence that includes the moderately well drained Tuscola soils and the poorly drained Colwood soils. Kibbie soils are on positions in the landscape similar to those of Jimtown soils. They have less coarse fragments in the solum than Jimtown soils.

The Kibbie soils in this county have a lighter colored surface layer than is defined for the series, and low chroma mottles are higher in the profile. These differences, however, do not alter the use or behavior of the soils.

Typical pedon of Kibbie fine sandy loam in an area of Kibbie-Bennington complex, 2 to 6 percent slopes, in Bucyrus Township, about 2,080 feet north and 1,600 feet east of the southwest corner of sec. 6, T. 3 S., R. 16 E.:

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) fine sandy loam; few medium faint grayish brown (10YR 5/2) mottles; moderate fine granular structure; friable; neutral; abrupt smooth boundary.

B1—10 to 17 inches; brown (10YR 5/3) silt loam; many coarse faint gray (10YR 5/1) and grayish brown (10YR 5/2) and common medium faint yellowish brown (10YR 5/4) mottles; moderate fine and medium subangular blocky structure; friable; medium acid; clear wavy boundary.

B21tg—17 to 30 inches; grayish brown (10YR 5/2) fine sandy loam; many medium faint yellowish brown (10YR 5/4) and gray (10YR 5/1) mottles; moderate medium subangular blocky structure; friable; medium patchy dark brown (7.5YR 4/2) clay films on horizontal and vertical faces of peds; few medium distinct dark brown (7.5YR 3/2) stains; neutral; clear wavy boundary.

B22t—30 to 45 inches; yellowish brown (10YR 5/4) silt loam; many medium distinct grayish brown (2.5Y 5/2) and many medium faint yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to weak subangular blocky; friable; thick patchy dark gray (10YR 4/1) clay films on vertical faces of peds and thin very patchy dark gray (10YR 4/1) clay films on horizontal faces of peds; neutral; gradual wavy boundary.

C1—45 to 53 inches; brown (10YR 5/3) loam; many medium faint yellowish brown (10YR 5/4) and gray (10YR 5/1) mottles; weak coarse prismatic structure; friable; mildly alkaline; gradual wavy boundary.

C2—53 to 61 inches; yellowish brown (10YR 5/4) sandy loam; many medium distinct gray (10YR 5/1) mottles; massive; friable; slightly stratified; mildly alkaline.

Solum thickness ranges from 36 to 48 inches. Reaction in the solum ranges from medium acid to neutral.

The Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3). An A2 horizon is in some pedons.

In the B horizon, hue is 10YR, value is 4 or 5, and chroma is 2 to 4. Texture is predominantly fine sandy loam, loam, or silt loam, but individual subhorizons can be silty clay loam or sandy clay loam. Weighted average clay content of the upper 20 inches of the Bt horizon is 20 to 30 percent.

In the C horizon, hue is 10YR, value is 5, and chroma is 2 to 4. Texture ranges from fine sand to silty clay. The C horizon is stratified.

Lenawee series

The Lenawee series consists of poorly drained and very poorly drained soils that have moderately slow permeability. These soils formed in calcareous lacustrine sediment. They are on glacial lake plains. Slopes range from 0 to 2 percent.

Lenawee soils are on positions in the landscape similar to those of Bono, Lenawee Variant, Luray, and Sebring soils. They are commonly near Sloan soils. Lenawee soils do not have a mollic epipedon, which Bono, Luray, and Sloan soils have. They are less acid than Lenawee Variant soils. Lenawee soils have more clay in the subsoil than Luray and Sebring soils. They do not have an irregular decrease in organic matter as depth increases, which Sloan soils have.

Typical pedon in an area of Lenawee silty clay loam, in Vernon Township, about 200 feet west and 2,800 feet north of the southeast corner of sec. 22, T. 21 N., R. 20 W.:

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam; moderate fine and medium granular structure; friable; many roots; slightly acid; abrupt smooth boundary.

B21g—9 to 12 inches; dark gray (N 4/0) silty clay; weak coarse prismatic structure parting to moderate medium angular blocky; firm; many roots; common fine distinct olive brown (2.5Y 4/4) streaks along root channels and very dark gray (10YR 3/1) organic coatings on vertical faces of peds; neutral; medium acid; clear smooth boundary.

B22g—12 to 18 inches; dark gray (N 4/0) silty clay loam; strong medium prismatic structure parting to moderate medium angular blocky; firm; common roots; many medium distinct dark yellowish brown (10YR 4/4) streaks along root channels and pores; very dark gray (10YR 3/1) organic coatings on vertical faces of peds; slightly acid; gradual wavy boundary.

B23g—18 to 30 inches; gray (N 5/0) silty clay loam; moderate medium prismatic structure; firm; common roots; very dark gray (10YR 3/1) organic coatings on vertical faces of peds; neutral; clear irregular boundary.

B3g—30 to 45 inches; variegated yellowish brown (10YR 5/4) and olive gray (5Y 5/2) silty clay loam; moderate medium prismatic structure; firm; common roots; common medium continuous dark grayish brown (2.5Y 4/2) coatings; gray (10YR 5/1) streaks and very dark gray (10YR 3/1) organic coatings on vertical faces of peds; mildly alkaline; clear irregular boundary.

Cg—45 to 60 inches; dark gray (5Y 4/1) silty clay loam; many medium distinct light olive brown (2.5Y 5/4) mottles; weak fine and medium platy structure; few silt and very fine sand laminations; firm; few roots; slight effervescence; mildly alkaline.

Solum thickness ranges from about 30 to 50 inches. Reaction is medium acid to neutral in the upper part of the solum and ranges to mildly alkaline in the lower part.

The Ap horizon is black (10YR 2/1) or very dark gray (10YR 3/1) but is dark grayish brown (10YR 4/2) in the overwashed areas. Texture is silty clay loam or silt loam.

The Bg horizon is silty clay loam or silty clay. Weighted average clay content in the control section is 35 to 45 percent. Hue is 10YR to 2.5Y or N; value is 4 to 6; and chroma is 1 or 2.

The C horizon is calcareous. It is laminated silt loam and silty clay loam and has thin layers of very fine sand and silt. Reaction is mildly alkaline.

Lenawee Variant

The Lenawee Variant consists of very poorly drained soils that have moderately slow permeability. These soils formed in lacustrine sediment that is high in silt and clay content. They once had an organic surface layer, which has been destroyed by oxidation or burning, or both, since the land has been drained and cultivated. They are in low-lying areas. Slopes range from 0 to 2 percent.

The Lenawee Variant soils are on positions in the landscape similar to those of Bono, Lenawee, Luray, and Sebring soils. They are near Sloan soils on flood plains. Lenawee Variant soils do not have a mollic epipedon, which Bono, Luray, and Sloan soils have. They are more acid and have weaker structure than Lenawee soils. Lenawee Variant soils have more clay in the subsoil than Luray and Sebring soils. They do not have an irregular decrease in organic matter as depth increases, which Sloan soils have.

Typical pedon in an area of Lenawee Variant silty clay loam, in Auburn Township, about 600 feet south and 400 feet west of the northeast corner of sec. 5, T. 22 N., R. 20 W.:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silty clay loam; weak fine granular structure; firm; neutral; abrupt smooth boundary.

B1g—8 to 15 inches; dark gray (N 4/0) silty clay; weak coarse prismatic structure; very firm; few yellowish brown (10YR 5/6) and yellowish red (5YR 5/6) streaks along root channels; very strongly acid; abrupt smooth boundary.

B21g—15 to 22 inches; gray (10YR 5/1) silty clay; weak coarse prismatic structure; firm; continuous dark gray (10YR 4/1) coatings on faces of peds; common yellowish brown (10YR 5/4) streaks along root channels; very strongly acid; clear wavy boundary.

B22g—22 to 32 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine distinct yellowish brown (10YR 5/4) mottles; weak coarse prismatic structure; firm; few brown (7.5YR 5/4) streaks along root channels; very strongly acid; gradual wavy boundary.

B3g—32 to 41 inches; grayish brown (2.5Y 5/2) silty clay loam; weak very coarse prismatic structure; firm; thick continuous gray (N 6/0) coatings on faces of peds; common strong brown (7.5YR 5/6) streaks along root channels; strongly acid; clear wavy boundary.

C1—41 to 60 inches; brown (10YR 5/3) silty clay loam and silt loam; many coarse distinct grayish brown (2.5Y 5/2) and gray (N 5/0) mottles; massive; partly stratified; firm; few strong brown (7.5YR 5/6) streaks along roots; medium acid; clear wavy boundary.

C2g—60 to 80 inches; stratified greenish gray (5G 5/1) silt loam and dark greenish gray (5GY 4/1) fine sandy loam; massive; greenish gray (5BG 5/1) streaks; friable; neutral.

The solum ranges from 20 to 45 inches in thickness and is free of coarse fragments throughout. Reaction in the upper part of the solum is very strongly acid to medium acid, unless the soil has been limed, but ranges to slightly acid in the lower part. Reaction in the C horizon is medium acid to mildly alkaline.

The Ap horizon is black (10YR 2/1), very dark grayish brown (10YR 3/2), or very dark gray (10YR 3/1). The content of organic matter is high but is not more than 25 percent.

In the Bg horizon, hue is 10YR, 2.5Y, or N; value is 4 to 6; and chroma is 0 to 2. Texture is mainly silty clay and silty clay loam, but some pedons have thin layers of silt loam. The clay content is higher in the upper part of the horizon.

The C horizon is brown to gray or greenish gray. It is stratified silt loam, silty clay loam, loam, and fine sandy loam.

Lobdell series

The Lobdell series consists of moderately well drained soils that have moderate permeability. These soils formed in alluvial sediment deposited by streams. They are on flood plains. Slopes range from 0 to 2 percent.

Lobdell soils are associated with the moderately well drained Medway soils, the somewhat poorly drained Shoals soils, and the very poorly drained Sloan soils on flood plains. They do not have a mollic epipedon, which Medway soils have.

Typical pedon in an area of Lobdell silt loam, in Whetstone Township, about 300 feet west and 2,400 feet north of the southeast corner of sec. 5, T. 4 S., R. 17 E.:

Ap—0 to 5 inches; brown (10YR 4/3) silt loam; strong fine granular structure; friable; neutral; clear wavy boundary.

A3—5 to 15 inches; dark grayish brown (10YR 4/2) silt loam; few fine faint brown (10YR 5/3) mottles; weak medium platy structure parting to moderate medium granular; friable; slightly acid; clear wavy boundary.

B21—15 to 20 inches; dark brown (10YR 4/3) silt loam; few medium faint brown (10YR 5/3) mottles; moderate medium subangular blocky structure; friable; many fine and medium pores; thin patchy light brownish gray (10YR 6/2) silt coatings; slightly acid; clear wavy boundary.

B22—20 to 31 inches; dark brown (10YR 4/3) silt loam; many medium faint grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) and few fine distinct dark brown (7.5YR 4/4) mottles; weak medium prismatic structure parting to moderate coarse subangular blocky; firm; thin patchy gray (10YR 5/1) coatings on faces of peds; slightly acid; gradual wavy boundary.

B3—31 to 50 inches; dark yellowish brown (10YR 4/4) silt loam; many medium faint yellowish brown (10YR 5/4) mottles; weak medium prismatic structure; friable; many fine and medium pores; horizontal streaks of very dark grayish brown (10YR 3/2) organic matter in lower part; continuous gray (10YR 5/1) coatings on faces of prisms; slightly acid; gradual wavy boundary.

C1—50 to 60 inches; dark brown (10YR 4/3) silt loam; common medium distinct strong brown (7.5YR 5/6) mottles; massive; friable; slightly acid; gradual wavy boundary.

C2—60 to 72 inches; dark brown (10YR 4/3) loam; common medium distinct strong brown (7.5YR 5/6) mottles; massive; friable; neutral.

Solum thickness ranges from 24 to 50 inches. Reaction in the solum ranges from strongly acid to neutral, and pebble content ranges from 0 to 10 percent.

The Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3).

In the B horizon, hue is 10YR, value is 4 or 5, and chroma is 3 or 4. Texture is silt loam or loam. The average clay content of the 10- to 40-inch layer is 18 to 25 percent.

The C horizon is stratified silt loam, loam, or sandy loam. Strata of sand or gravel are present below a depth of 40 inches in many pedons.

Luray series

The Luray series consists of very poorly drained soils that have moderately slow permeability. These soils formed in calcareous lacustrine sediment that is high in silt content. They are in broad flat areas or slight depressions on glacial lake basins. Slopes range from 0 to 2 percent.

Luray soils are members of a drainage sequence that includes the somewhat poorly drained Fitchville soils and the poorly drained Sebring soils. Luray soils are on positions in the landscape similar to those of Bono, Lenawee, Lenawee Variant, and Sebring soils. They are near Sloan soils. Luray soils have less clay in the subsoil than Bono, Lenawee, and Lenawee Variant soils. They have a mollic epipedon, which Lenawee, Lenawee Variant, and Sebring soils do not have. Luray soils do not have an irregular decrease in organic matter as depth increases, which Sloan soils have.

Typical pedon in an area of Luray silty clay loam, in Tod Township, about 1,000 feet west of Knauss Road and 2,100 feet north of River Road, NE1/4SE1/4 sec 12, T. 3 S., R. 15 E.:

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silty clay loam; moderate medium granular structure; friable; many roots; medium acid; abrupt smooth boundary.

A3—7 to 10 inches; very dark gray (10YR 3/1) silty clay loam; common fine distinct yellowish brown (10YR 5/6) and few medium prominent yellowish red (5YR 4/8) mottles; moderate medium subangular blocky structure; friable; many roots; medium acid; clear wavy boundary.

B21tg—10 to 15 inches; dark gray (10YR 4/1) silty clay loam; common fine distinct dark brown (7.5YR 4/4) and few fine distinct yellowish brown (10YR 5/6) mottles; moderate fine prismatic structure parting to moderate medium subangular blocky; firm; common fine roots; thin continuous clay films in root channels and pores; few thin patchy silt coatings; slightly acid; clear wavy boundary.

B22tg—15 to 20 inches; dark gray (10YR 4/1) silty clay loam; many medium faint gray (10YR 5/1) and many fine distinct dark yellowish brown (10YR 4/4) mottles; moderate medium prismatic structure parting to moderate coarse subangular blocky; firm; common fine roots; thin continuous dark grayish brown (10YR 4/2) clay films in pores and root channels; slightly acid; gradual wavy boundary.

B23tg—20 to 30 inches; grayish brown (10YR 5/2) silty clay loam; common fine distinct dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) mottles; moderate coarse prismatic structure parting to moderate coarse subangular blocky; firm; common fine roots; thin patchy dark grayish brown (10YR 4/2) clay films in pores and root channels; few yellowish red (5YR 4/6) streaks along root channels; neutral; gradual wavy boundary.

B24g—30 to 40 inches; gray (10YR 5/1) silt loam; common fine distinct yellowish brown (10YR 5/6) mottles; moderate coarse prismatic structure parting to moderate coarse subangular blocky; firm; few fine roots; common reddish brown (5YR 4/4) streaks along root channels; neutral; gradual wavy boundary.

B3g—40 to 50 inches; gray (10YR 5/1) silt loam; common fine faint grayish brown (10YR 5/2) and common fine distinct yellowish brown (10YR 5/6) and dark brown (7.5YR 4/4) mottles; weak coarse prismatic structure with weak thin lamination in interior of prisms; firm; few fine roots; neutral; clear irregular boundary.

C1g—50 to 66 inches; gray (10YR 5/1) silty clay loam and brown (10YR 4/3) very fine sand in weak thin and medium laminations; friable; slight effervescence; mildly alkaline; clear smooth boundary.

C2g—66 to 80 inches; dark grayish brown (10YR 4/2) silt loam and olive brown (2.5Y 4/4) very fine sand in strong medium and thin laminations; firm; slight effervescence; moderately alkaline; abrupt smooth boundary.

C3g—80 to 95 inches; gray (10YR 5/1) silty clay loam; massive; very firm; slight effervescence; mildly alkaline.

Solum thickness ranges from 30 to 60 inches. Reaction is medium acid to neutral in the solum and slightly acid to moderately alkaline in the C horizon. Depth to carbonates is more than 36 inches.

The mollic epipedon ranges from 10 to 14 inches in thickness and is black (10YR 2/1), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2). These colors are in the A1 or Ap horizon, and in some pedons, they extend into the upper part of the B horizon.

In the B2 horizon, hue is 10YR to 5Y, value is 4 or 5, and chroma is 1 or 2. Texture is heavy silt loam or silty clay loam. Weighted average clay content is 25 to 35 percent.

The B3 and C horizons are predominantly stratified silty clay loam and silt loam. Thin strata of loam, fine sandy loam, or sandy loam are common. In some pedons, glacial till is as shallow as 40 inches.

Lykens series

The Lykens series consists of moderately well drained soils that have moderately slow or slow permeability. These soils formed in glacial lake sediment and the underlying glacial till. They are on water-modified till plains. Slopes range from 2 to 6 percent.

Lykens soils are members of a drainage sequence that includes the somewhat poorly drained Tiro soils. Lykens soils are on positions in the landscape similar to those of Cardington and Glynwood soils. They are more silty in the upper part of the solum than Cardington and Glynwood soils.

Typical pedon in an area of Lykens silt loam, 2 to 6 percent slopes, in Whetstone Township, about 400 feet east and 900 feet south of the northwest corner of sec. 16, T. 3 S., R. 17 E.:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; weak medium granular structure; friable; many roots; neutral; abrupt smooth boundary.

B1—8 to 13 inches; yellowish brown (10YR 5/4) silt loam; moderate fine and medium subangular blocky structure; friable; many roots; many fine pores; thin patchy brown (10YR 5/3) clay films and thin patchy silt coatings on faces of peds; common dark grayish brown (10YR 4/2) fillings in root channels; few fine dark concretions; strongly acid; clear smooth boundary.

B21t—13 to 17 inches; yellowish brown (10YR 5/4) heavy silt loam; strong fine and medium subangular blocky structure; friable; many roots; thin patchy brown (10YR 5/3) clay films on faces of peds; very strongly acid; clear smooth boundary.

B22t—17 to 22 inches; yellowish brown (10YR 5/4) light clay loam; many medium distinct yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; friable; common fine roots; medium continuous brown (10YR 5/3) clay films on faces of prisms; thin patchy brown (10YR 5/3) clay films on horizontal faces of peds; very strongly acid; clear wavy boundary.

IIB23t—22 to 29 inches; brown (7.5YR 4/4) light clay loam; many coarse distinct strong brown (7.5YR 5/6) mottles in thin sand lenses; moderate medium prismatic structure; firm; common roots; thin patchy light brownish gray (10YR 6/2) clay films on faces of prisms; strongly acid in upper part grading to medium acid in lower part; clear wavy boundary.

IIIB3t—29 to 39 inches; dark yellowish brown (10YR 4/4) silty clay loam; many medium distinct yellowish brown (10YR 5/6) and gray (10YR 5/1) mottles; moderate coarse prismatic structure; firm; few fine roots; thin patchy dark grayish brown (10YR 4/2) clay films on faces of prisms; 4 percent coarse fragments; neutral; clear wavy boundary.

IIIC—39 to 75 inches; dark yellowish brown (10YR 4/4) light clay loam; many medium yellowish brown (10YR 5/6) and gray (10YR 5/1) mottles; massive; very firm; common fine black shale fragments; 4 percent coarse fragments; slight effervescence; moderately alkaline.

Solum thickness ranges from 24 to 50 inches. The depth to carbonates ranges from 28 to 50 inches. The thickness of the overlying silty mantle ranges from 20 to 36 inches. The mantle is underlain by weakly stratified loamy material 2 to 15 inches thick, and below this is material derived from till. Reaction ranges from neutral to strongly acid in the upper part of the B horizon, and strongly acid to mildly alkaline in the lower part of the B horizon. Coarse fragment content is less than 2 percent in the silty layers in the upper part of the solum, 0 to 25 percent in the loamy part of the solum, 3 to 10 percent in the lower part of the solum and in the C horizon.

The Ap horizon is dark brown (10YR 4/3) or dark grayish brown (10YR 4/2). The A1 horizon is 1 to 4 inches thick and is very dark grayish brown (10YR 3/2) to black (10YR 2/1). The A2 horizon, where present, is 2 to 8 inches thick below an A1 horizon and 0 to 4 inches thick below an Ap horizon. The A2 horizon is brown (10YR 5/3) or pale brown (10YR 6/3).

In the B2 and IIB2 horizons, hue is 10YR or 7.5YR, value is 4 or 5, and chroma is 3 to 6. The B2 horizon is silt loam, silty clay loam, or clay loam. The IIB2 or IIB3 horizon is clay loam, silty clay loam, or loam.

In the IIIC horizon, hue is 10YR or 2.5Y, value is 4 or 5, and chroma is 2 to 4. Texture is clay loam, silty clay loam, loam, and silt loam.

Marengo series

The Marengo series consists of very poorly drained soils that have moderate permeability. These soils formed in glacial till that is low in lime content. They are in local depressions and swales on till plains. Slopes range from 0 to 2 percent.

Marengo soils are members of the drainage sequence that includes the well drained Alexandria soils, the moderately well drained Cardington soils, the somewhat poorly drained Bennington soils, the poorly drained Condit soils, and the very poorly drained Pewamo soils. Marengo soils are on positions in the landscape similar to those of Condit and Pewamo soils. They have less clay in the subsoil than Condit and Pewamo soils. They have a mollic epipedon, which Condit soils do not have.

Typical pedon in an area of Marengo silty clay loam, in Auburn Township, about 1,300 feet east and 1,100 feet south of the northwest corner of sec. 34, T. 22 N., R. 20 W.:

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silty clay loam; moderate medium granular structure; friable; slightly acid; abrupt smooth boundary.

A12—7 to 13 inches; very dark gray (10YR 3/1) silty clay loam; moderate medium subangular blocky structure; firm; slightly acid; clear wavy boundary.

B1g—13 to 17 inches; dark grayish brown (2.5Y 4/2) silty clay loam; moderate medium subangular blocky structure; firm; many medium very dark gray (10YR 3/1) organic coatings; 2 percent pebbles; slightly acid; clear smooth boundary.

B21tg—17 to 23 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to weak coarse subangular blocky; firm; thin patchy dark gray (10YR 4/1) coatings; thin very patchy clay films on faces of peds; 3 percent pebbles; neutral; clear smooth boundary.

B22tg—23 to 36 inches; light brownish gray (2.5Y 6/2) clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure; firm; thin patchy grayish brown (10YR 5/2) coatings; thin very patchy clay films on faces of peds; 2 percent pebbles; mildly alkaline; gradual smooth boundary.

B3—36 to 53 inches; yellowish brown (10YR 5/4) clay loam; many medium faint yellowish brown (10YR 5/6) and many medium distinct grayish brown (2.5Y 5/2) mottles; weak very coarse prismatic structure; firm; 4 inch-thick band of sandy clay loam; 5 percent pebbles; mildly alkaline; abrupt wavy boundary.

C1—53 to 72 inches; olive brown (2.5Y 4/4) clay loam; common medium distinct gray (10YR 5/1) and few medium distinct brownish yellow (10YR 6/6) mottles; massive; very firm; 8 percent pebbles; slight effervescence; mildly alkaline; gradual smooth boundary.

C2—72 to 80 inches; olive brown (2.5Y 4/4) loam; massive; very firm; few black (10YR 2/1) stains; 8 percent pebbles; slight effervescence; mildly alkaline.

Solum thickness ranges from 45 to 70 inches. Reaction ranges from medium acid or slightly acid in the upper part of the solum and from slightly acid to mildly alkaline in the lower part, unless the soil has been limed. Pebble content in the solum ranges from 2 to 15 percent.

In the A horizon, hue is 10YR, value is 2 or 3, and chroma is 1 or 2.

In the B1 and B2 horizons, hue is 10YR, 2.5Y, or N; value is 4 to 6; and chroma is 0 to 2. Texture is silty clay loam, clay loam, loam, or silt loam. Weighted average clay content is 25 to 35 percent.

In the C horizon, hue is 10YR or 2.5Y, value is 4 or 5, and chroma is 2 to 4.

Medway series

The Medway series consists of moderately well drained soils that have moderate permeability. These soils formed in alluvial sediment. They are on flood plains. Slopes range from 0 to 2 percent.

Medway soils are associated with the moderately well drained Lobdell soils, the somewhat poorly drained Shoals soils, and the very poorly drained Sloan soils on flood plains. They have a mollic epipedon, which Lobdell soils do not have.

Typical pedon in an area of Medway silt loam, in Dallas Township, about 1,200 feet east and 200 feet north of the southwest corner of sec. 25, T. 3 S., R. 15 E.:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam; moderate medium granular structure; very friable; mildly alkaline; abrupt smooth boundary.

A12—8 to 18 inches; very dark brown (10YR 2/2) silt loam, dark brown (10YR 3/3) rubbed; weak medium prismatic structure parting to moderate fine and medium granular; neutral; clear smooth boundary.

B1—18 to 32 inches; yellowish brown (10YR 5/4) silt loam; few fine distinct grayish brown (2.5Y 5/2) and common medium faint dark yellowish brown (10YR 4/4) mottles; moderate medium prismatic structure parting to weak medium subangular blocky; friable; grayish brown (2.5Y 5/2) silt coatings on vertical surfaces; neutral; clear wavy boundary.

B2—32 to 40 inches; yellowish brown (10YR 5/4) loam; many medium distinct grayish brown (10YR 5/2) mottles; weak coarse prismatic structure; friable; neutral; clear wavy boundary.

C1—40 to 54 inches; yellowish brown (10YR 5/4) sandy loam; many medium distinct grayish brown (10YR 5/2) mottles; massive; friable; neutral; clear smooth boundary.

C2—54 to 60 inches; brown (10YR 4/3) gravelly loamy sand; single grained; loose; slight effervescence; mildly alkaline.

Solum thickness ranges from 28 to 50 inches. The mollic epipedon ranges from 12 to 24 inches in thickness. Reaction in the solum ranges from slightly acid to moderately alkaline. Coarse fragment content is less than 5 percent throughout the solum.

In the A horizon, hue is 10YR and value and chroma are 2 or 3.

In the B horizon, hue is predominantly 10YR but is 7.5YR to 2.5Y in some pedons, value is 4 or 5, and chroma is 2 to 4. In some pedons, the upper part of the B horizon is part of the mollic epipedon and has value of 3 and chroma of 2 or 3. Texture is predominantly loam or silt loam but is clay loam, silty clay loam, sandy loam, and fine sandy loam in some subhorizons. Weighted average clay content of the control section is 20 to 32 percent.

In the C horizon, hue is 7.5YR to 2.5Y, value is 4 or 5, and chroma is 1 to 6. Texture is mainly loam, silt loam, and sandy loam. Gravelly and sandy strata are below a depth of 40 inches. Reaction is generally neutral but ranges to moderately alkaline in some pedons.

Mitiwanga series

The Mitiwanga series consists of somewhat poorly drained soils that have moderate permeability. These soils are moderately deep to sandstone bedrock. They formed in glacial till and residuum of the underlying sandstone bedrock. They are adjacent to intermittent streams on the uplands.

The Mitiwanga soils are commonly adjacent to Bennington soils. They have bedrock within a depth of 40 inches, which Bennington soils do not have.

Typical pedon in an area of Mitiwanga silt loam, 0 to 3 percent slopes, in Jefferson Township, SW1/4NE1/4 sec. 1, about 700 feet north and 200 feet east of the center of sec. 1, T. 16 N., R. 21 W.:

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam; strong medium granular structure; friable; 5 percent pebbles; very strongly acid; clear wavy boundary.

A2—7 to 11 inches; yellowish brown (10YR 5/4) silt loam; common medium distinct gray (10YR 5/1) and common fine faint yellowish brown (10YR 5/8) mottles; moderate medium platy structure parting to weak fine granular; friable; 5 percent pebbles; very strongly acid; gradual smooth boundary.

B21t—11 to 20 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct gray (10YR 5/1) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; medium continuous light grayish brown (10YR 5/2) silt coatings on faces of peds; medium continuous clay films on faces of peds; 5 percent pebbles; very strongly acid; gradual smooth boundary.

B22t—20 to 31 inches; yellowish brown (10YR 5/4) clay loam; common medium distinct grayish brown (10YR 5/2) and common medium faint yellowish brown (10YR 5/6) mottles; weak medium prismatic structure; firm; medium patchy dark grayish brown (10YR 4/2) clay films on faces of peds; many medium dark concretions; few fine grained sandstone fragments; 5 percent pebbles; very strongly acid; clear wavy boundary.

IIB3—31 to 34 inches; yellowish brown (10YR 5/4) sandy loam; common medium distinct grayish brown (10YR 5/2) and common medium faint yellowish brown (10YR 5/6) mottles; massive; firm; 10 percent fine grained sandstone fragments; slightly acid; clear wavy boundary.

IIR—34 to 60 inches; gray (N 5/0) sandstone bedrock; massive; fine grained.

The depth to sandstone bedrock ranges from 20 to 40 inches. Reaction is very strongly acid to medium acid in the upper part of the solum, unless the soil has been limed, and strongly acid to slightly acid in the lower part. Coarse fragment content ranges from 5 to 15 percent throughout the solum and generally increases as depth increases to a maximum immediately above the bedrock.

The Ap horizon is dark grayish brown or grayish brown in a hue of 10YR or 2.5Y.

In the B horizon, hue is 10YR or 2.5Y, value is 4 or 5, and chroma is 3 or 4. Texture is sandy loam, loam, silt loam, silty clay loam, and clay loam. Weighted average clay content is 24 to 30 percent, but clay content in individual subhorizons can be as low as 18 percent.

A C horizon is present in some pedons. It is loam, clay loam, or their channery analogs.

Muskego series

The Muskego series consists of very poorly drained soils. These soils formed in moderately deep organic deposits over coprogenous material. Permeability is moderate in the organic material and slow in the coprogenous material. These soils are on the fringes of extensive bog regions or are in potholes on ground moraines and end moraines. Slopes are 0 to 2 percent.

Muskego soils are on positions in the landscape similar to those of Carlisle and Olentangy soils. Muskego soils have less than 51 inches of sapric material in the surface tier, and Carlisle soils have more than 51 inches. Muskego soils have 16 inches or more of sapric material, and Olentangy soils have less than 16 inches.

Typical pedon in an area of Muskego muck, in Polk Township, about 900 feet west and 300 feet south of the center of sec. 30, T. 20 N., R. 20 W.:

Oap—0 to 9 inches; black (10YR 2/1) broken and rubbed, sapric material; about 15 percent fiber, none rubbed; moderate fine granular structure; very friable; slightly acid; abrupt smooth boundary.

Oa2—9 to 17 inches; very dark brown (10YR 2/2) rubbed, sapric material; 5 percent fiber, none rubbed; moderate medium subangular blocky structure; firm; neutral; clear smooth boundary.

Oa3—17 to 20 inches; very dark grayish brown (10YR 3/2) sapric material; 30 percent fiber, 3 percent rubbed; laminated; friable; many small shells; slight effervescence; mildly alkaline; abrupt smooth boundary.

Lco1—20 to 44 inches; olive gray (5Y 4/2) coprogenous material; laminated; firm; strong brown (7.5YR 5/6) coarse vertical streaks; slight effervescence; mildly alkaline; clear smooth boundary.

Lco2—44 to 60 inches; olive (5Y 5/4) coprogenous material; laminated; firm; many small shells; slight effervescence; mildly alkaline.

The depth to limnic material ranges from 16 to 50 inches. The fiber in the sapric layers is derived mainly from herbaceous plants. A few common woody fragments, twigs, and branches, 1/4 inch to 3 inches in diameter, make up less than 10 percent of the volume of some pedons. Reaction is medium acid to mildly alkaline in the surface tier and neutral or mildly alkaline in the subsurface tier.

The lower part of the subsurface and bottom tiers consists of laminated, coprogenous (sedimentary peat) material, in which the hue is 2.5Y or 5Y, value is 4 to 6, and chroma is 1 to 4. Shells are few to many. The tiers are laminated or have very thin platy structure. They are slightly plastic. They shrink on drying and form hard clods that are difficult to rewet.

Olentangy series

The Olentangy series consists of very poorly drained soils that formed in moderately thick deposits of coprogenous earth. Permeability is moderate in the upper part and slow in the underlying mineral material. These soils are in depressions in lakebeds and till plains. Slopes are 0 to 2 percent.

Olentangy soils are on positions in the landscape similar to those of Carlisle, Muskego, and Wallkill soils. Olentangy soils have a thinner layer of sapric material on the surface than Carlisle or Muskego soils. They do not have a mineral soil layer on the surface, which Wallkill soils have.

Typical pedon in an area of Olentangy mucky silt loam, in Cranberry Township, about 400 feet north of State Route 98 and 900 feet east of Stevens Road, SE1/4SW1/4 sec. 36, T. 18 N., R. 21 W.:

Lcop—0 to 9 inches; black (10YR 2/1) broken, mucky silt loam, 60 percent mineral; very dark brown (10YR 2/2) rubbed; moderate very fine granular structure; friable; medium acid; abrupt smooth boundary.

Lco2—9 to 18 inches; dark brown (7.5YR 4/2) silt loam, 75 percent mineral; reddish brown (5YR 4/4 and 5/4) streaks; moderate fine prismatic structure; friable; very strongly acid; clear wavy boundary.

Lco3—18 to 36 inches; dark brown (7.5YR 3/2) silt loam; reddish brown (5YR 4/4) streaks; moderate medium prismatic structure; medium laminations in prism interiors; friable; strongly acid; clear wavy boundary.

Lco4—36 to 42 inches; dark brown (7.5YR 3/2) silt loam; reddish brown (5YR 4/4 and 5/4) streaks and dark reddish brown (5YR 3/4) vertical pipe stems; weak thick platy structure; dark red (2.5YR 3/6) leaf impressions on plates; common very fine calcium sulfate crystals; friable; medium acid; abrupt smooth boundary.

Lco5—42 to 48 inches; dark greenish gray (5GY 4/1) silt loam, 85 percent mineral; common medium prominent dark yellowish brown (10YR 4/4) mottles; weak medium lamination; friable; common very fine calcium sulfate crystals along cracks and channels; mildly alkaline; clear wavy boundary.

IICg—48 to 60 inches; dark greenish gray (5GY 4/1) silt loam; common medium prominent dark yellowish brown (10YR 4/4) mottles; massive; friable; few white (10YR 8/1) shells and fragments; slight effervescence; moderately alkaline.

The thickness of the coprogenous earth and the depth to lacustrine sediment or glacial till range from 24 to 50 inches. Reaction in the Lco layers (coprogenous earth) ranges from extremely acid to mildly alkaline. Reaction in the underlying mineral horizons is mildly alkaline or moderately alkaline.

In the surface layer, hue is 10YR, 7.5YR, or N; value is 2 or 3; and chroma is 0 to 2.

In the Lco layers (coprogenous earth), hue is 10YR to 5YR, value is 3 to 5, and chroma is 2 to 4; material below a depth of 24 inches can have hue of 5GY and chroma of 1. The coprogenous earth is predominantly mineral and commonly is silt loam or light silty clay loam. Leaf impressions and other plant remnants are in some pedons. Gypsum crystals along root channels and cracks are in some pedons.

In the IIC horizon, hue is 10YR, 5G, or N; value is 4 to 6; and chroma is 0 to 2. Texture is silt loam, silty clay loam, clay loam, or loam. Shell fragments are in the lower part of the coprogenous material and in the C horizon of some pedons.

Olmsted series

The Olmsted series consists of very poorly drained soils that have moderate permeability. These soils formed in loamy and sandy outwash and alluvium that contain some gravel. They are on terraces, outwash plains, and deltas and on some morainic uplands. Slopes are 0 to 2 percent.

Olmsted soils are members of a drainage sequence that includes the well drained Chili soils, the moderately well drained Bogart soils, and the somewhat poorly drained Jimtown soils. Olmsted soils are on positions in the landscape similar to those of Colwood soils. They have more gravel in the solum than Colwood soils.

Typical pedon in an area of Olmsted silty clay loam, in Polk Township, about 1,200 feet north of Monnett-New Winchester Road and 1,700 feet west of Iberia Road, SW1/4NW1/4 sec. 3, T. 19 N., R. 21 W.:

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silty clay loam; weak coarse granular structure; friable; slightly acid; abrupt smooth boundary.

A12—7 to 10 inches; very dark grayish brown (10YR 3/2) silty clay loam; weak medium subangular blocky structure; friable; slightly acid; clear smooth boundary.

IIB1g—10 to 17 inches; dark gray (10YR 4/1) clay loam; many medium distinct yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; firm; continuous grayish brown (2.5Y 5/2) coatings on faces of peds; 5 percent pebbles; neutral; clear wavy boundary.

IIB2tg—17 to 26 inches; light brownish gray (2.5Y 6/2) loam; weak medium subangular blocky structure; friable; thin patchy clay films bridging sand grains; 10 percent gravel; neutral; clear wavy boundary.

IIIB31g—26 to 32 inches; dark grayish brown (10YR 4/2) silt loam; many coarse distinct strong brown (7.5YR 5/6) and dark gray (N 4/0) mottles; weak coarse prismatic structure; friable; neutral; clear smooth boundary.

IIIB32—32 to 40 inches; yellowish brown (10YR 5/4) silt loam; many coarse distinct strong brown (7.5YR 5/6) and dark gray (N 4/0) mottles; weak coarse prismatic structure; friable; 10 percent gravel; neutral; clear smooth boundary.

IVC1g—40 to 54 inches; very dark gray (N 3/0) gravelly loamy sand; single grained; loose; 25 percent gravel; mildly alkaline; clear smooth boundary.

IVC2g—54 to 60 inches; dark gray (N 4/0) sand; single grained; loose; 10 percent pebbles; slight effervescence; mildly alkaline.

Solum thickness ranges from 30 to 50 inches. Coarse fragment content is generally less than 10 percent in the upper part of the solum. In the lower part and in the underlying material, it is 10 to 50 percent. Reaction ranges from medium acid to neutral in the A and B horizons and neutral or mildly alkaline in the C horizon.

In the Ap and A12 horizons, hue is 10YR, value is 2 or 3, and chroma is 1 or 2.

In the B1 and B2 horizons, hue is 10YR to 5Y or N, value is 4 to 6, and chroma is 0 to 2. The B3 horizon has colors similar to those of the B2 horizon but can have chroma of 3 to 6. Texture in the B horizon is loam, clay loam, sandy loam, silt loam, and their gravelly analogs.

The C horizon is sand, loamy sand, sandy loam, loam, clay loam, or their gravelly analogs.

Pewamo series

The Pewamo series consists of very poorly drained soils that have moderately slow permeability. These soils formed in calcareous glacial till. They are in low-lying areas or depressions on till plains. Slopes range from 0 to 2 percent.

Pewamo soils are members of a drainage sequence that includes the moderately well drained Glynwood soils and the somewhat poorly drained Blount soils. In some areas, Pewamo soils are in a drainage sequence with the well drained Alexandria soils, the moderately well drained Cardington soils, the somewhat poorly drained Bennington soils, and the poorly drained Condit soils.

Pewamo soils are on positions in the landscape similar to those of Condit and Marengo soils. Pewamo soils have a mollic epipedon, which Condit soils do not have. They have more clay in the subsoil than Marengo soils.

Typical pedon in an area of Pewamo silty clay loam, in Bucyrus Township, about 3,300 feet west and 1,600 feet south of the northeast corner of sec. 15, T. 3 S., R. 16 E.:

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) silty clay loam; weak medium granular structure; firm; many roots; slightly acid; abrupt smooth boundary.

B21tg—10 to 20 inches; grayish brown (10YR 5/2) silty clay loam; common fine faint brown (10YR 5/3) and few fine distinct yellowish brown (10YR 5/4) mottles; moderate fine prismatic structure parting to moderate medium subangular blocky; firm; common roots; dark gray (10YR 4/1) root channels; medium very patchy dark gray (10YR 4/1) clay films on vertical and horizontal faces of peds; slightly acid; clear smooth boundary.

B22tg—20 to 27 inches; gray (10YR 5/1) silty clay loam; many medium distinct yellowish brown (10YR 5/4 and 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; common roots; thin patchy dark gray (10YR 4/1) coatings on vertical faces of peds and root channels; medium very patchy clay films on vertical faces of peds; slightly acid; clear smooth boundary.

B23g—27 to 39 inches; gray (10YR 5/1) silty clay loam; common fine distinct dark brown (10YR 4/3) and many fine distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure; firm; common roots; thin patchy dark gray (10YR 4/1) coatings; medium very patchy clay films on vertical faces of peds; neutral; clear smooth boundary.

B31—39 to 63 inches; yellowish brown (10YR 5/4) silty clay loam; common fine faint yellowish brown (10YR 5/6) and common fine distinct dark brown (10YR 4/3) mottles; moderate coarse prismatic structure; very firm; few roots; thin patchy gray (10YR 5/1) coatings on vertical faces of peds; neutral; clear wavy boundary.

B32—63 to 69 inches; dark yellowish brown (10YR 4/4) silty clay loam; common fine distinct gray (10YR 5/1) and common fine faint yellowish brown (10YR 5/4) mottles; weak coarse prismatic structure; firm; neutral; clear wavy boundary.

C1—69 to 93 inches; olive brown (2.5Y 4/4) clay loam; common fine distinct grayish brown (10YR 5/2) mottles; massive; very firm; 5 percent pebbles; slight effervescence; mildly alkaline.

Solum thickness ranges from 30 to 70 inches. Reaction is medium acid to neutral in the upper part of the solum and neutral or mildly alkaline in the lower part. Reaction is mildly alkaline or moderately alkaline in the C horizon. The depth to carbonates is 50 to 70 inches. The coarse fragment content ranges from 0 to 10 percent throughout the solum.

The mollic epipedon is 10 to 14 inches thick. It is black (10YR 2/1), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2).

The B2g horizon is heavy clay loam, silty clay loam, or light silty clay. The upper 20 inches has clay content of 35 to 45 percent. In the B2g horizon, hue is 10YR or 2.5Y, value is 4 to 6, and chroma is 1 or 2.

The C horizon is predominantly clay loam but is silty clay loam in places. Carbonates have leached from part of the C horizon in some pedons.

Sebring series

The Sebring series consists of poorly drained soils that have moderately slow permeability. These soils formed in calcareous lacustrine sediment that is high in silt content. They are on flats and in depressions in glacial lake basins. Slopes are 0 to 2 percent.

Sebring soils are members of a drainage sequence that includes the somewhat poorly drained Fitchville soils and the very poorly drained Luray soils. Sebring soils are on positions in the landscape similar to those of Bono, Lenawee, Lenawee Variant, and Luray soils. Sebring soils do not have a mollic epipedon, which Bono and Luray soils have. They have less clay in the subsoil than Bono, Lenawee, and Lenawee Variant soils.

Typical pedon in an area of Sebring silt loam, in Chatfield Township, about 600 feet south and 600 feet east of the northwest corner of sec. 30, T. 1 S., R. 17 E.:

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam; weak fine granular structure; friable; common fine distinct light olive brown (2.5Y 5/4) mottles; slightly acid; abrupt smooth boundary.

B1g—9 to 15 inches; dark gray (10YR 4/1) silty clay loam; many medium distinct light olive brown (2.5Y 5/4) and dark brown (7.5YR 4/4) mottles; moderate fine angular blocky structure; firm; medium continuous dark gray (10YR 4/1) coatings on faces of peds; few fine dark brown (7.5YR 3/2) concretions; slightly acid; gradual wavy boundary.

B21tg—15 to 22 inches; dark gray (5Y 4/1) silty clay loam; many medium distinct gray (10YR 5/1) and yellowish brown (10YR 5/4) mottles; moderate medium angular blocky structure; firm; thin very patchy clay films and clean fine sand grains on faces of peds; few fine dark brown (7.5YR 3/2) concretions; slightly acid; gradual wavy boundary.

B22tg—22 to 31 inches; dark gray (5Y 4/1) silty clay loam; many medium distinct gray (10YR 5/1) and yellowish brown (10YR 5/4) mottles; weak medium prismatic structure parting to moderate medium angular blocky; firm; thin very patchy clay films; few fine dark brown (7.5YR 3/2) concretions; neutral; gradual wavy boundary.

B3g—31 to 45 inches; gray (5Y 5/1) silty clay loam; many medium distinct yellowish brown (10YR 5/4) mottles; moderate medium and coarse prismatic structure; firm; gray (5Y 5/1) coatings on faces of prisms; neutral; gradual wavy boundary.

C1—45 to 65 inches; dark yellowish brown (10YR 4/4) silt loam; many coarse faint yellowish brown (10YR 5/4) mottles; weakly stratified thin layers of very fine sand; mildly alkaline.

Solum thickness ranges from 30 to 55 inches. Reaction is slightly acid to very strongly acid in the upper part of the solum, unless the soil has been limed, and medium acid to neutral in the lower part. Reaction is slightly acid to mildly alkaline in the C horizon. The solum is essentially free of coarse fragments.

The Ap horizon is dark gray (10YR 4/1) or dark grayish brown (10YR 4/2).

The B horizon is heavy silt loam or silty clay loam. The total clay content is 22 to 35 percent. Hue is 10YR to 5Y or N, value is 4 or 5, and chroma is 0 to 2.

The C horizon is predominantly stratified silt loam and silty clay loam, but thin strata of sandy loam, loam, or clay loam are also common.

Shoals series

The Shoals series consists of somewhat poorly drained soils that have moderate permeability. These soils formed in alluvial sediment deposited by streams. They are on flood plains throughout the county. Slopes range from 0 to 2 percent.

Shoals soils are associated with the moderately well drained Lobdell and Medway soils and the very poorly drained Sloan and Wallkill soils on flood plains. Shoals soils are wetter than Lobdell and Medway soils but are better drained than Sloan and Wallkill soils. They do not have a buried organic layer, which Wallkill soils have.

Typical pedon in an area of Shoals silt loam, in Jackson Township, about 100 feet north and 300 feet east of the southwest corner of sec. 16, T. 20 N., R. 20 W.:

Ap—0 to 11 inches; dark grayish brown (10YR 4/2) silt loam; weak coarse granular structure; friable; neutral; abrupt smooth boundary.

B1—11 to 16 inches; brown (10YR 5/3) silt loam; common medium distinct light brownish gray (2.5Y 6/2) mottles; weak medium subangular blocky structure; friable; slightly acid; clear smooth boundary.

B2g—16 to 30 inches; grayish brown (2.5Y 5/2) silt loam; many medium distinct yellowish brown (10YR 5/4) and many medium faint dark grayish brown (2.5Y 4/2) mottles; moderate medium prismatic structure parting to weak medium subangular blocky; friable; neutral; clear smooth boundary.

B3g—30 to 40 inches; gray (10YR 6/1) loam; many medium distinct yellowish brown (10YR 5/4) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; neutral; clear wavy boundary.

C1g—40 to 50 inches; gray (10YR 6/1) loam; many coarse distinct yellowish brown (10YR 5/4) mottles; massive; friable; mildly alkaline; clear smooth boundary.

C2g—50 to 60 inches; gray (10YR 6/1) gravelly loam; massive; stratified; friable; 20 percent pebbles; slight effervescence; mildly alkaline.

Solum thickness is 24 to 40 inches. Reaction is slightly acid to mildly alkaline in the upper 40 inches and neutral to mildly alkaline below 40 inches.

In the B horizon, hue is 10YR or 2.5Y, value is 4 to 6, and chroma is 1 to 3. Texture is predominantly silt loam and loam, but individual subhorizons can be silty clay loam. The total clay content in the 10- to 40-inch zone is 18 to 27 percent.

The C horizon is loam, silt loam, sandy loam, loamy sand, or their gravelly analogs.

Sloan series

The Sloan series consists of very poorly drained soils that have moderate permeability. These soils formed in alluvial sediment deposited by streams. They are on flood plains along major streams in the county. Slopes range from 0 to 2 percent.

Sloan soils are associated with the moderately well drained Lobdell and Medway soils and the somewhat poorly drained Shoals soils on flood plains. Sloan soils are wetter than these soils. Sloan soils are near Bono, Lenawee, Lenawee Variant, Luray, and Sebring soils. Unlike these soils, Sloan soils have an irregular decrease in organic matter as depth increases. Sloan soils have a mollic epipedon, which Lenawee, Lenawee Variant, and Sebring soils do not have.

Typical pedon in an area of Sloan silt loam, in Dallas Township, about 1,200 feet west and 2,600 feet south of the northeast corner of sec. 7, T. 4 S., R. 16 E.:

A1—0 to 12 inches; very dark gray (10YR 3/1) silt loam; moderate fine and medium granular structure; friable; neutral; clear smooth boundary.

B1g—12 to 18 inches; very dark grayish brown (10YR 3/2) silt loam; moderate medium prismatic structure parting to moderate medium subangular blocky; friable; thick continuous very dark grayish brown (10YR 3/2) coatings on vertical faces of peds; neutral; clear wavy boundary.

B2g—18 to 30 inches; dark grayish brown (10YR 4/2) silt loam; common fine distinct gray (10YR 5/1) and yellowish brown (10YR 5/4) mottles; moderate medium prismatic structure parting to weak medium subanglar blocky; firm; medium continuous dark gray (10YR 4/1) coatings on vertical faces of peds; 2 percent pebbles; neutral; abrupt smooth boundary.

B3—30 to 48 inches; light olive brown (2.5Y 5/4) silt loam; many medium distinct gray (10YR 5/1) and yellowish brown (10YR 5/6) mottles; moderate coarse prismatic structure; firm; dark gray (N 4/0) and gray (N 5/0) coatings on faces of peds; 2 percent pebbles; neutral; abrupt smooth boundary.

IIC—48 to 75 inches; yellowish brown (10YR 5/4) loam; many coarse distinct gray (N 5/0) mottles; massive; friable; mildly alkaline; abrupt smooth boundary.

Solum thickness ranges from 30 to 50 inches. Reaction is slightly acid to mildly alkaline in the upper part of the B horizon and neutral to moderately alkaline in the lower part of the B horizon and in the C horizon.

The mollic epipedon is 10 to 20 inches thick. It is black (10YR 2/1), very dark gray (10YR 3/1), or very dark brown (10YR 2/2).

The B horizon is predominantly silt loam and silty clay loam, but loam and clay loam are common. The total clay content in the 10- to 40-inch zone is 22 to 33 percent. In the gleyed part of the B horizon, hue is 10YR to 5Y, value is 4 or 5, and chroma is 1 or 2. Sandy and gravelly strata are common below a depth of 3 feet in some pedons.

Tiro series

The Tiro series consists of somewhat poorly drained soils that have moderately slow or slow permeability in the lower part of the subsoil and in the substratum. These soils formed in glacial lake sediment and the underlying glacial till. They are in water-modified till plains. Slopes range from 0 to 6 percent.

Tiro soils are members of a drainage sequence that includes the moderately well drained Lykens soils. They are on positions in the landscape similar to those of Wadsworth soils. They do not have a fragipan, which Wadsworth soils have.

Typical pedon in an area of Tiro silt loam, 0 to 2 percent slopes, in Jefferson Township, about 2,000 feet east of State Route 602 and 400 feet north of Windfall Road, SE1/4SW1/4 sec. 15, T. 16 N., R. 21 W.:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; weak fine granular structure; friable; many roots; neutral; abrupt smooth boundary.

B&A—8 to 11 inches; light brownish gray (2.5Y 6/2) light silty clay loam (B2t); many coarse prominent yellowish brown (10YR 5/4 and 5/6) mottles; moderate fine subangular blocky structure; friable; common fine roots; many fine pores; thin patchy grayish brown (2.5Y 5/2) silt coatings (A2) on faces of peds; very strongly acid; clear smooth boundary.

B21tg—11 to 17 inches; yellowish brown (10YR 5/4) silty clay loam; many medium prominent light brownish gray (2.5Y 6/2) mottles; strong medium subangular blocky structure; firm; common fine roots; thin continuous grayish brown (2.5Y 5/2) clay films on vertical faces and thin patchy clay films on horizontal faces of peds; thin very patchy light brownish gray (2.5Y 6/2) silt coatings which partly coat clay films on vertical faces of peds; very strongly acid; clear wavy boundary.

B22tg—17 to 23 inches; yellowish brown (10YR 5/4) heavy silty clay loam; few fine distinct grayish brown (10YR 5/2) mottles; moderate medium prismatic structure parting to moderate medium and coarse subangular blocky; firm; common fine roots; grayish brown (2.5Y 5/2) medium continuous clay films on vertical faces and thin patchy clay films on horizontal faces of peds; many coarse black (10YR 2/1) stains; medium acid; clear wavy boundary.

B23tg—23 to 28 inches; gray (10YR 5/1) light silty clay loam; common coarse distinct yellowish brown (10YR 5/4) mottles; moderate coarse prismatic structure parting to moderate coarse subangular blocky; firm; common fine roots; gray (10YR 5/1) medium continuous clay films on vertical surfaces and thin very patchy on horizontal surfaces; common coarse black (10YR 2/1) stains; medium acid; clear irregular boundary.

IIB31g—28 to 36 inches; light brownish gray (2.5Y 6/2) loam; common medium prominent yellowish brown (10YR 5/4) mottles; weak coarse prismatic structure; friable; common fine roots; many fine pores; 2 percent pebbles; neutral; abrupt irregular boundary.

IIIB32g—36 to 46 inches; gray (10YR 5/1) loam; common coarse distinct yellowish brown (10YR 5/4) mottles; weak coarse prismatic structure; firm; few fine black (10YR 2/1) stains; 5 percent coarse fragments; neutral; clear wavy boundary.

IIIC—46 to 72 inches; brown (10YR 4/3) light clay loam; massive; firm; grayish brown (10YR 5/2) streaks along fracture planes; 5 percent coarse fragments, common black shale, few limestone pebbles; moderately alkaline; slight effervescence.

Solum thickness ranges from 30 to 55 inches. Depth to the IIB horizon ranges from 22 to 36 inches. Depth to the IIIB or IIIC horizon ranges from 30 to 40 inches. Reaction ranges from slightly acid to very strongly acid in the upper part of the solum, unless the soil has been limed, and from slightly acid to moderately alkaline in the lower part. Coarse fragment content is less than 1 percent in the upper silty mantle; 0 to 5 percent in the loamy part of the solum; and 3 to 10 percent, by volume, in the lower part of the B horizon and in the C horizon that formed in glacial till.

The Ap horizon is dark gray (10YR 4/1) to grayish brown (10YR 5/2). The A1 horizon, when present, is 1 to 4 inches thick and is very dark grayish brown (10YR 3/2) to black (10YR 2/1). In the A2 horizon, where present, hue is 10YR or 2.5Y, value is 5 or 6, and chroma is 2 or 3.

In the B horizon, hue is 7.5YR to 2.5Y, value is 4 to 6, and chroma is 1 to 6. Texture is silty clay loam or heavy silt loam in the upper part; loam, sandy loam, or clay loam in the middle part; and loam, clay loam, or silty clay loam in the lower part.

In the C horizon, hue is 10YR or 2.5Y, value is 4 or 5, and chroma is 2 to 4. Texture is heavy loam, clay loam, or silty clay loam.

Tuscola series

The Tuscola series consists of moderately well drained soils that have moderate permeability. These soils formed in calcareous, water-deposited sediment. They are along the margins of former glacial lakes. Slopes range from 2 to 6 percent.

Tuscola soils are members of a drainage sequence that includes the somewhat poorly drained Kibbie soils and the very poorly drained Colwood soils. Tuscola soils are on positions in the landscape similar to those of Bogart soils. They have less coarse fragments in the solum and are less acid than Bogart soils.

Typical pedon in an area of Tuscola fine sandy loam, 2 to 6 percent slopes, in Cranberry Township, about 1,400 feet east of Boundary Road and 2,200 feet south of Scott Road, SE1/4SW1/4 of sec. 3, T. 18 N., R. 21 W.:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) fine sandy loam; weak medium granular structure; friable; slightly acid; abrupt smooth boundary.

B1—8 to 16 inches; yellowish brown (10YR 5/4) sandy loam; common fine faint brown (10YR 5/3) mottles; moderate medium subangular blocky structure; friable; medium acid; clear wavy boundary.

B21t—16 to 25 inches; brown (10YR 5/3) sandy loam; common medium distinct yellowish brown (10YR 5/6 and 5/8), few medium faint grayish brown (10YR 5/2), and few medium distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; thin patchy very dark grayish brown (10YR 3/2) clay films on faces of peds; firm; medium acid; clear wavy boundary.

B22t—25 to 34 inches; dark yellowish brown (10YR 4/4) sandy loam; common medium distinct yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; thin patchy very dark grayish brown (10YR 3/2) clay films on faces of peds; slightly acid; clear wavy boundary.

B23t—34 to 40 inches; dark brown (10YR 4/3) clay loam; common medium distinct yellowish brown (10YR 5/6 and 5/8) and gray (10YR 5/1) mottles; moderate medium subangular blocky structure; firm; thin patchy very dark grayish brown (10YR 3/2) clay films on horizontal and vertical faces of peds; neutral; clear smooth boundary.

B24t—40 to 44 inches; dark yellowish brown (10YR 4/4) sandy clay loam; many medium distinct yellowish brown (10YR 5/6 and 5/8) and grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; friable; thin very patchy dark brown (10YR 3/3) clay films on horizontal and vertical faces of peds; neutral; clear smooth boundary.

B3—44 to 46 inches; dark brown (10YR 4/3) clay loam; common medium distinct grayish brown (10YR 5/2) and common medium faint dark yellowish brown (10YR 4/4) mottles; moderate medium angular blocky structure; firm; neutral; abrupt smooth boundary.

C1—46 to 52 inches; dark brown (10YR 4/3) sandy loam; few fine faint dark yellowish brown (10YR 4/4) mottles; weak platy structure; friable; slight effervescence; mildly alkaline; clear smooth boundary.

C2g—52 to 59 inches; grayish brown (10YR 5/2) silt loam; many medium faint gray (10YR 5/1) and many medium distinct dark yellowish brown (10YR 4/4) mottles; massive; firm; slight effervescence; moderately alkaline; clear smooth boundary.

C3—59 to 66 inches; dark brown (10YR 4/3) sandy loam; many medium distinct yellowish brown (10YR 5/4) mottles; massive; friable; laminated; slight effervescence; moderately alkaline.

Solum thickness ranges from 36 to 50 inches. Reaction is medium acid to neutral in the solum and mildly alkaline or moderately alkaline in the C horizon. Coarse fragments are typically absent throughout the solum.

The Ap horizon is dark grayish brown (10YR 4/2) or dark gray (10YR 4/1).

In the B horizon, hue is 10YR, value is 4 or 5, and chroma is 3 or 4. Texture is sandy loam, silt loam, clay loam, silty clay loam, and sandy clay loam. Total clay content of the upper 20 inches of the Bt horizon is 18 to 30 percent.

In the C horizon, hue is 10YR, value is 4 to 6, and chroma is 2 or 3. Texture is sandy loam, silt loam, loamy sand, and fine sand.

Wadsworth series

The Wadsworth series consists of somewhat poorly drained soils that have slow or very slow permeability. These soils have a fragipan. They formed in low lime glacial till that is high in sandstone and clay shale content. These soils are on till plains. Slopes range from 0 to 6 percent.

Wadsworth soils are on positions in the landscape similar to those of Tiro soils. Wadsworth soils have a fragipan, which Tiro soils do not have.

Typical pedon in an area of Wadsworth silt loam, 0 to 2 percent slopes, in Polk Township, about 200 feet north of Morrow-Crawford County Line Road and 2,200 feet east of State Route 19, SE1/4SW1/4 of sec. 4, T. 19 N., R. 20 W.:

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam; moderate fine granular structure; friable; strongly acid; abrupt smooth boundary.

A2—9 to 13 inches; grayish brown (10YR 5/2) silt loam; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium platy structure; firm; very strongly acid; clear smooth boundary.

B21t—13 to 24 inches; yellowish brown (10YR 5/6) silty clay loam; common fine distinct grayish brown (2.5Y 5/2) mottles; strong medium prismatic structure parting to moderate medium subangular blocky; firm; medium continuous light brownish gray (2.5Y 6/2) silt coatings and medium very patchy dark grayish brown (10YR 4/2) clay films along vertical faces of peds; very strongly acid; clear smooth boundary.

Bx1—24 to 30 inches; yellowish brown (10YR 5/6) silty clay loam; many medium distinct light gray (10YR 6/1) mottles; moderate very coarse prismatic structure; very firm; medium patchy grayish brown (2.5Y 5/2) clay films; 2 percent pebbles; very strongly acid; gradual smooth boundary.

Bx2—30 to 36 inches; dark brown (10YR 4/3) clay loam; many medium distinct yellowish brown (10YR 5/6), brownish yellow (10YR 6/6), and brown (7.5YR 5/2) mottles; moderate very coarse prismatic structure parting to moderate thick platy; very firm; thick patchy gray (10YR 6/1) clay films on vertical faces of peds; 2 percent pebbles; strongly acid; gradual smooth boundary.

B3t—36 to 48 inches; dark brown (10YR 4/3) heavy clay loam; many coarse distinct yellowish brown (10YR 5/6), brownish yellow (10YR 6/6), and brown (7.5YR 5/2) mottles; moderate coarse prismatic structure parting to moderate thick platy; firm; thick patchy gray (10YR 6/1) clay films on vertical faces of peds; 5 percent pebbles; mildly alkaline; clear smooth boundary.

C—48 to 65 inches; dark brown (10YR 4/3) clay loam; many coarse distinct yellowish brown (10YR 5/6), brownish yellow (10YR 6/6), and brown (7.5YR 5/2) mottles; massive; friable; 5 percent pebbles; slight effervescence; moderately alkaline.

Solum thickness ranges from 40 to 55 inches. The depth to the fragipan ranges from 18 to 28 inches. Unless the soil has been limed, reaction above the fragipan is medium acid to extremely acid and becomes less acid in and below the fragipan as depth increases. The depth to calcareous till is 40 to 60 inches. Coarse fragment content is less than 2 percent in the solum above the fragipan, and it is 2 to 8 percent in the fragipan, the lower part of the solum, and the C horizon.

In the Ap horizon, hue is 10YR or 2.5Y, value is 4 or 5, and chroma is 1 to 3. The A1 horizon is a very dark grayish brown (10YR 3/2) and is 2 to 4 inches thick. An A2 horizon is commonly present under the A1 and Ap horizons but has been mixed in with the Ap horizon in many plowed areas.

In the B2t horizon, hue is 10YR or 2.5Y, value is 4 or 5, and chroma is 4 to 6. Texture is silty clay loam or clay loam. Clay content ranges from 28 to 35 percent.

In the Bx horizon, hue is 10YR or 2.5Y, value is 4 or 5, and chroma is 3 to 6. Texture is silty clay loam, clay loam, heavy silt loam, or heavy loam. Clay content is 25 to 32 percent.

The C horizon is loam, silt loam, or light clay loam.

Wallkill series

The Wallkill series consists of very poorly drained soils that have moderate permeability in the mineral part of the solum. These soils formed in 16 to 30 inches of alluvium over organic soil material. They are in small, deep depressions in the lake plains and till plains; and in larger areas on the flood plains. Slopes are 0 to 2 percent.

Wallkill soils are on positions in the landscape similar to those of Carlisle, Muskego, and Olentangy soils. Wallkill soils have a mineral upper layer, which Carlisle, Muskego, and Olentangy soils do not have. They have a buried organic layer, which Shoals soils do not have.

Typical pedon in an area of Wallkill silt loam, in Auburn Township, about 500 feet south and 3,000 feet east of the northwest corner of sec. 6, NE1/4NE1/4, T. 22 N., R. 20 W.:

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam; moderate medium granular structure; friable; neutral; clear smooth boundary.

A3—9 to 16 inches; dark grayish brown (10YR 4/2) silt loam; few fine distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) mottles; moderate medium platy structure; friable; brown (10YR 5/3) streaks of very fine sand; neutral; abrupt smooth boundary.

Bg—16 to 22 inches; dark gray (10YR 4/1) silt loam; many medium faint dark grayish brown (10YR 4/2) and few medium distinct black (10YR 2/1) mottles; weak medium subangular blocky structure parting to moderate fine granular; friable; many worm channels; neutral; abrupt wavy boundary.

IIOa1—22 to 26 inches; black (10YR 2/1) sapric material; 20 percent fiber, 5 percent rubbed; common very coarse distinct yellowish brown (10YR 5/4) and gray (10YR 5/1) mottles; weak medium granular structure; friable; neutral; clear wavy boundary.

IIOa2—26 to 34 inches; black (10YR 2/1) sapric material; 20 percent fiber, 10 percent rubbed; strong medium platy structure; firm; medium acid; clear wavy boundary.

IIOa3—34 to 80 inches; black (10YR 2/1) sapric material; 20 percent fiber, 5 percent rubbed; weak medium platy structure; laminated; friable; slightly acid; clear wavy boundary.

The mineral layer is 16 to 30 inches thick. Reaction is strongly acid to mildly alkaline in the mineral layer and medium acid to mildly alkaline in the organic layer.

The Ap horizon is dark gray (10YR 4/1) or dark grayish brown (10YR 4/2).

In the Bg horizon, hue is 10YR or 2.5Y, value is 4 or 5, and chroma is 1 or 2. Texture is silt loam or light silty clay loam.

The organic layer is at least 20 inches thick and consists of sapric or hemic material.

Wilmer Variant

The Wilmer Variant consists of moderately well drained soils that have moderate permeability. These soils formed in glacial melt water deposits. They are on end moraines and outwash plains. Slopes range from 0 to 6 percent.

Wilmer Variant soils are on positions in the landscape similar to those of Bogart soils. They have a mollic epipedon, which Bogart soils do not have.

Typical pedon in an area of Wilmer Variant silt loam, 0 to 2 percent slopes, in Polk Township, about 1,000 feet west and 700 feet north of the southeast corner of sec. 35, T. 16 N., R. 21 W.:

Ap—0 to 10 inches; very dark brown (10YR 2/2) silt loam, very dark grayish brown (10YR 3/2) rubbed; moderate medium granular structure; friable; many roots; 2 percent pebbles; neutral; clear smooth boundary.

A3—10 to 13 inches; very dark brown (10YR 2/2) silt loam; strong medium subangular blocky structure; firm; many roots; brown (10YR 5/3) and grayish brown (10YR 5/2) silt coatings; very dark grayish brown (10YR 3/2) organic coatings; thin very patchy brown (10YR 5/3) clay films on faces of peds; 5 percent pebbles; neutral; gradual smooth boundary.

B1t—13 to 17 inches; yellowish brown (10YR 5/4) clay loam; moderate medium and fine subangular blocky structure; firm; many roots; brown (10YR 5/3) and grayish brown (10YR 5/2) silt coatings; very dark grayish brown (10YR 3/2) organic coatings; thin very patchy brown (10YR 5/3) clay films on faces of peds; 5 percent pebbles; neutral; gradual smooth boundary.

B21t—17 to 24 inches; yellowish brown (10YR 5/4) clay loam; moderate medium subangular blocky structure; firm; common roots; thin continuous grayish brown (10YR 5/2) silt coatings; thin patchy brown (10YR 5/3) clay films on faces of peds; neutral; 5 percent pebbles; clear wavy boundary.

B22t—24 to 30 inches; yellowish brown (10YR 5/4) clay loam; common fine distinct gray (10YR 5/1) and grayish brown (10YR 5/2) and few medium faint yellowish brown (10YR 5/6) mottles; weak medium and coarse subangular blocky structure; firm; common roots; medium patchy brown (10YR 5/3) clay films on faces of peds; 8 percent pebbles; neutral; gradual wavy boundary.

B31—30 to 38 inches; yellowish brown (10YR 5/4) sandy loam; few fine faint yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure; friable; few roots; grayish brown (10YR 5/2) coatings on vertical faces of peds; 10 percent pebbles; mildly alkaline; clear smooth boundary.

B32—38 to 50 inches; yellowish brown (10YR 5/4) loam; weak coarse prismatic structure parting to weak coarse subangular blocky; friable; few roots; grayish brown (10YR 5/2) coatings on faces of prisms; 10 percent pebbles; mildly alkaline; clear smooth boundary.

IIC—50 to 60 inches; dark brown (10YR 4/3) clay loam; massive; firm; yellowish brown (10YR 5/4) and gray (10YR 5/1) streaks along fractures; 5 percent pebbles; slight effervescence; mildly alkaline.

Solum thickness ranges from 30 to 54 inches. Reaction is medium acid to neutral in the upper part of the solum and neutral to mildly alkaline in the lower part. Coarse fragment content ranges from 2 to 20 percent in the solum.

The mollic epipedon is 10 to 14 inches thick. Hue is 10YR, value is 2 or 3, and chroma is 2. It can extend into the B horizon.

In the B horizon, hue is 10YR, value is 4 or 5, and chroma is 3 or 4. Texture is clay loam, loam, sandy clay loam, sandy loam, and their gravelly analogs. The lower part of the B horizon formed in till in some pedons.

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" (*15*).

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 Mollisol.

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 Aquoll (*Aqu*, meaning water, plus *oll*, from Mollisol).

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 Argiaquolls (*Argi*, meaning white clay, plus *aquoll*, the suborder of Mollisols that have an aquic 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 Argiaquolls.

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 Argiaquolls.

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 lists the factors and some of the processes of soil formation and describes how they have affected the formation of soils in Crawford County.

Factors of soil formation

A soil is a three-dimensional, natural body capable of supporting plant growth. The nature of the soil at a given site is the result of the interaction of many factors. These factors can be grouped into five general categories: parent material, climate, plants and animals, relief, and time. Theoretically, if all these factors are identical at different sites, soils at these sites also should be identical. The variations among soils are caused by variations in one or more of these factors.

Parent material

Parent material is the raw material acted upon by the other soil-forming factors. It largely determines the soil texture. The soils of Crawford County formed in different kinds of parent material. Some of this material was deposited by glaciers that covered the area thousands of years ago, or by melt water from these glaciers. Other kinds of parent material is alluvium deposited by flowing streams in relatively recent times, or residuum derived from rock weathered in place, or organic material accumulated from decaying plants.

Glacial till was deposited directly by glacial ice and had little or no action by water. The glacier contained assorted soil material, which remained when the glacier melted. Glacial till typically contains particles that vary in size. Some till contains large stones. The smaller stones and pebbles have sharp angles, indicating that they have not been rounded by the action of water. The composition of the till depends on the nature of the area over which the ice passed before reaching the area of deposition. Some boulders were carried for long distances, but most of the material in the till was of local origin. Most of the glacial till in Crawford County was deposited during the latest major glaciation, the Wisconsin Glaciation. The glacial till plains of Crawford County are made up of till in ground moraines or end moraines. These two types of glacial till exhibit diverse properties. They exist on separate landforms that reflect difference in method and rate of till deposition.

Ground moraine till deposits are characteristically massive, compact, and dense and have slow permeability. They make up the level to gently undulating till plains of Crawford County and were deposited beneath the glacial ice as it advanced. Bennington, Condit, and Pewamo soils formed in these deposits.

End moraine till deposits are characteristically more variable in texture and are sometimes stratified or waterworked. These deposits are also less dense and more permeable than the ground moraine deposits. They make up the moderately rolling, hummocky relief of Crawford County. These moraine ridges mark the edge of the glacier during periods when the ice fronts were relatively stationary. Alexandria and Marengo soils formed in these deposits.

The natural lime, shale, sandstone, and crystalline rock content of glacial till deposits generally reflects the influence of local underlying bedrock deposits. Limestone bedrock, Columbus and Delaware Formations, occupy much of the western part of the county. The glacial till which passed over the limestone area has a higher lime content. The limestone-influenced till was deposited in the southwestern part of Crawford County in which Blount, Glynwood, and Pewamo soils formed. This till averages about 15 percent calcium carbonate equivalent. It contains about 25 percent sand, 48 percent silt, 27 percent clay, and 4 percent coarse fragments.

Shale bedrock of the Ohio and Olentangy Formations underlies much of the central part of Crawford County. The glacial till that passed over this bedrock was deposited in the northwestern and central parts of the county. This till contains more shale and has some sandstone and less lime than the till deposits in the southwestern part of the county. Alexandria, Bennington, Cardington, and Marengo soils formed in this shale-influenced till. This till averages about 10 percent calcium carbonate equivalent. Particle-sized distribution is about 23 percent sand, 51 percent silt, 26 percent clay, and 6 percent coarse fragments.

The Berea Sandstone Formation influences a small area of the southeastern part of the county. The content of sandstone fragments is noticeably higher in this area of Wadsworth soils.

Melt water deposits were laid down by, or in, water from the melting glaciers. There are two general kinds: lacustrine deposits, laid down in still water; and outwash deposits, laid down by moving water. The size of particles that can be carried suspended in water depends on the speed of the moving water. When water slows to a given speed, all particles larger than a given size that are suspended in the water will drop out. Reduction of speed occurs where a stream flows into a still lake. The coarser sand and gravel particles are dropped immediately near the mouth of the stream, and the fine clay particles are carried far into the lake, where they slowly settle from the still water.

Lacustrine soils are extensive in Crawford County. Fitchville, Luray, and Lenawee soils are examples. These soils formed in deposits laid down in small lakes that existed after the glaciers melted.

Surging melt waters from the glacier deposited sand and gravel along outwash channels and on deltas, kames, and eskers in Crawford County. The melt water washed away the smaller silt- and clay-size particles, leaving behind sand and gravel. Such soils as Chili, Jimtown, Olmstead, and Bogart formed in the outwash material.

The speed of water at many points was not constant during the period of deposition. Changes in the speed of the water caused stratification, or the deposition of thin layers of material in which the predominant particle size differs from that in the layers above and below. In many areas of Colwood, Kibbie, and Tuscola soils, for example, there are alternating thin strata of silt loam and sandy loam. Even more drastic changes in material deposition are indicated by such "two-story" soils as Gallman soils. The upper part of these soils formed in loamy deposits laid down in still water, but the lower part formed in sandy or gravelly deposits laid down by moving water. Lykens and Tiro soils formed in lacustrine silt and clay and the underlying glacial till.

Alluvium is soil material deposited by flowing streams. Texture varies because the speed and duration of floodwater vary considerably within small areas. The soil horizons are poorly expressed because the soil-forming process repeats with each new deposition. One or more buried surface layers is present in many areas, and the soils are highly stratified. The source of most alluvium is other soils farther upstream in the watershed. Lobdell, Shoals, and Sloan soils formed in alluvium.

Weathered rock is the parent material of only one soil in the county, Mitiwanga soils. These soils formed partly in residuum of sandstone bedrock. Carlisle soils and the upper part of Muskego and Olentangy soils formed in decomposed plant residue. Plants died and fell into shallow lakes. Here, the permanently wet condition prevented oxidation and slowed decomposition, and the residue accumulated. The very dark color of these soils is from their organic parent material.

Climate

Climate in an area the size of Crawford County is essentially a constant factor of soil formation. None of the soil differences in the county can be directly attributed to differences in climate. The climate is humid and temperate which favors hardwood trees.

Some differences in microclimate affect the amount of precipitation. The amount of effective precipitation is reduced by runoff on steep slopes and is increased by drainage in depressions.

Plants and animals

The vegetation under which a soil forms influences the color, structure, and content of organic matter. Soils that formed under trees are generally lighter colored than those that formed under grass, because grass is more effective than trees in returning organic matter to the soil. Grass also promotes granular structure in the surface layer of the soil.

Most soils in Crawford County formed under hardwood trees. Alexandria, Bennington, and Cardington soils formed mainly under such hardwoods as red oak, white oak, and black oak. Sebring, Condit, and most of the other poorly drained and very poorly drained soils formed under trees in swamps.

Bacteria, fungi, and many other micro-organisms aid in the breakdown and return of plant residue to the soil. The kind of organic residue that is returned to the soil depends, to some extent, on the kind of organism involved in the breakdown. Generally, fungi are most active in acid soils and bacteria, in alkali soils.

Earthworms, burrowing insects, and other small animals constantly mix the soil. Their burrows help to make the soil porous and permit the passage of water. Earthworms help to incorporate organic matter into the soil. Leaf fall that is well populated with earthworms is generally incorporated into the soil early in the following spring. If the earthworm population is low, part of the leaf fall remains on the surface of the soil for 2 or 3 years.

Accelerated erosion caused by cultivation and clearing is one example of man's influence on soil formation. Cultivation also affects soil structure and tends to lower the content of organic matter. Large areas of Pewamo, Luray, and other wet soils have been drained artificially. Future soil formation in these areas will take place under drier conditions than those in the past. The change of vegetation from native trees to cultivated crops can also be expected to affect future soil formation. The addition of lime, fertilizer, and other amendments changes the chemical composition of the soil to some degree.

Relief

Relief, along with parent material, affects the natural drainage of soils. It influences the amount of runoff and depth to the ground water table. Generally, the steeper soils have better drainage than the nearly level soils. Different kinds of soil can form in the same kind of parent material under different drainage conditions. For example, Alexandria and Marengo soils formed in glacial till deposits. Alexandria soils are in high positions where the water table generally is not close to the surface. Water passes through these soils readily, and they are well drained. Marengo soils, however, are in low, nearly level areas in which the water table is close to the surface. Even though these soils are permeable enough for water to pass through them, water tends to accumulate in them, and they are very poorly drained.

A group of soil series that formed in the same kind of parent material but have different natural drainage is called a drainage sequence, or soil catena. For example, the well drained Alexandria soils, the moderately well drained Cardington soils, the somewhat poorly drained Bennington soils, the poorly drained Condit soils, and the very poorly drained Marengo soils make up a drainage sequence of soils that formed in clay loam glacial till.

The greatest relief in Crawford County is associated with the strongly sloping soils and dissected land adjacent to the flood plains of such major waterways throughout the county as Sycamore and Brokensword Creeks and Olentangy and Sandusky Rivers. Pronounced relief is also associated with the hummocky, moderately rolling soils that formed in end moraine deposits. These ridges are generally oriented northeast to southwest and extend throughout the county. They are well pronounced in the northeastern part of the county, near Tiro and Sulphur Springs and east and west of New Washington. Better drained soils, such as Alexandria and Cardington, are on this topography.

Time

The length of time during which parent material has been exposed to the soil-forming processes affects the nature of the soil that forms. The youngest soils in the county, in terms of years, are the soils in recent stream deposits, such as Lobdell and Shoals soils. These soils have less definite horizon development than older soils.

Glacial deposits of the Wisconsin age in Crawford County are geologically young. Yet, sufficient time has elapsed in exposing the original material to the active forces of climate and biotic factors to produce horizon development. In most soils, carbonates have been leached to a depth of more than 3 feet, structure has developed in the subsoil, and organic matter has accumulated in the surface layer.

Processes of soil formation

Soil forms through complex, continuing processes that are grouped into four general categories: addition, removal, transfer, and alteration (*12*). These processes occur in the formation of all soils, although their predominance varies.

In Crawford County, the accumulation of organic matter in the formation of mineral soils is an example of the addition process. This addition of organic residue is mainly responsible for a dark colored surface layer. When the parent material was laid down, the upper part was no darker than the rest, but the organic residue from plants that grew in the soil darkened the surface layer.

The loss of lime from the upper 3 to 6 feet of many of the soils in Crawford County is an example of the removal process. The parent material of these soils was limy, but the lime has been leached from the upper part of the profile by water that moved through the soil.

Water is the carrier for most of the transfers that occur in the formation of soils in this county. In many soils, clay has been transferred from the A horizon to the B horizon. Thus the A horizon, especially the A2, is a zone of eluviation, or loss. The B horizon is a zone of illuviation, or gain. In Cardington, Bennington, and other soils, the B horizon contains more clay than the parent material, and the A2 horizon contains less. In the B horizon of some soils, thin clay films are in the pores and on ped surfaces. This clay has been moved from the A horizon. The presence or absence of these clay films is an important criterion in soil classification.

The reduction and solution of ferrous iron, an example of the alteration process, has taken place in the very poorly drained and somewhat poorly drained soils. This reduction of iron, called gleying, is evident in Colwood, Condit, and Luray soils because of a recurring water table. Gray colored soil indicates a condition favorable to the reduction process. Reduced iron is soluble, but in Crawford County, it has commonly been moved only a short distance, stopping either in the horizon where it originated or in an underlying one. Part of this iron can be reoxidized and segregated to form the commonly observed bright yellow and red mottles. Mottling in all but the well drained soils is caused by alteration of iron in the soil.

The four soil-forming processes have worked in all the soils of the county, but to varying degrees. For example, the accumulation of organic matter has been predominant in the formation of Luray and Pewamo soils, whereas the removal of carbonates and the transfer of clay have been predominant in the formation of Cardington and Bennington soils.

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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.

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

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.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

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.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is 40 or 80 inches (1 or 2 meters).

Coprogenous earth (sedimentary peat). Organic and inorganic materials either deposited in water by precipitation or by action of aquatic organisms such as algae or diatoms, or derived from underwater and floating aquatic plants subsequently modified by aquatic animals.

Cutbanks cave. Unstable walls of cuts made by earthmoving equipment. The soil sloughs easily.

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.

Esker (geology). A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess fines. Excess silt and clay. The soil does not provide a source of gravel or sand for construction purposes.

Fast intake. The rapid movement of water into the soil.

Fine textured (heavy textured) soil. Sandy clay, silty clay, and clay.

Flooding. The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; *November-May*, for example, means that flooding can occur during the period November through May. Water standing for short periods after rainfall or commonly covering swamps and marshes is not considered flooding.

Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

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.

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.

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.

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.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. Inadequate strength for supporting loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is greater than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Moderately coarse textured (moderately light textured) soil. Sandy loam and fine sandy loam.

Moderately fine textured (moderately heavy textured) soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Types are terminal, lateral, end, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse* more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material mixed with mineral soil material. The content of organic matter is more than 20 percent.

Munsell notation. A designation of color by degrees of the three single variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by water that originated mainly from the melting of glacial ice. Glacial outwash is commonly in valleys on landforms known as valley trains, outwash terraces, eskers, kame terraces, kames, outwash fans, or deltas.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

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 pipelike cavities in the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from a semisolid to a plastic state.

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.

Poor outlets. Surface or subsurface drainage outlets difficult or expensive to install.

Productivity (soil). The capability of a soil for producing a specified plant or sequence of plants under a specified system of management. Productivity is measured in terms of output, or harvest, in relation to input.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

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.

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.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Seepage. The rapid movement of water through the soil. Seepage adversely affects the specified use.

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.

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.

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.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow intake. The slow movement of water into the soil.

Slow refill. The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones. Rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Small stones adversely affect the specified use.

Soil. A natural, three-dimensional body at the earth's surface that is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *very coarse sand* (2.0 millimeters to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

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 (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. A stream terrace is frequently called a second bottom, in contrast with a flood plain, and is seldom subject to overflow. A marine terrace, generally wide, was deposited by the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer. Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil (engineering). Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

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.

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.

Illustrations

Figure 1.—A grassed waterway in areas of gently sloping Bennington silt loam and Lenawee silty clay loam.

Figure 2.—Shrinkage cracks in the drying surface layer of Bono silty clay loam.

Figure 3.—Lenawee silty clay loam is used for soybeans. This soil formed in lacustrine material in former glacial lakes.

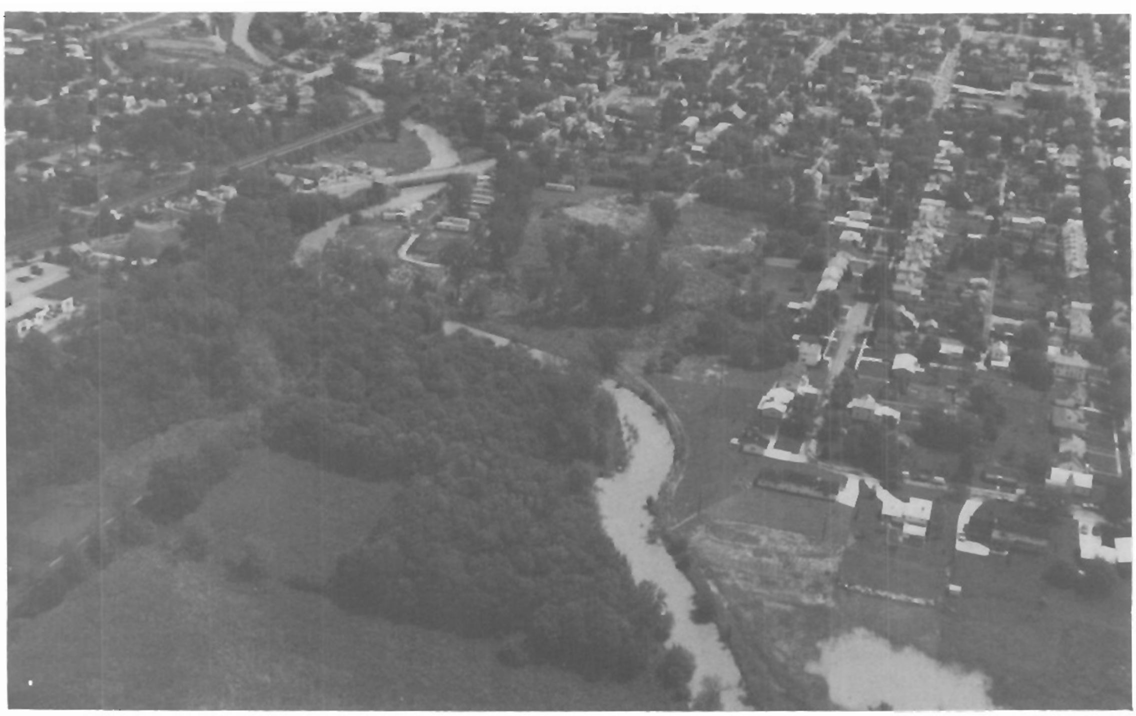

Figure 4.—Lobdell silt loam on flood plains of the Sandusky River at Bucyrus. Flooding is a severe limitation to the use of this soil.

Figure 5.—Native red maple, silver maple, American elm, swamp white oak, and other water-tolerant trees on Luray silty clay loam.

Figure 6.—A windbreak of spruce trees on Luray silty clay loam.

Figure 7.—Crops respond well to drainage of the light colored Bennington soil in the foreground and the darker colored Pewamo soil in the lower lying positions.

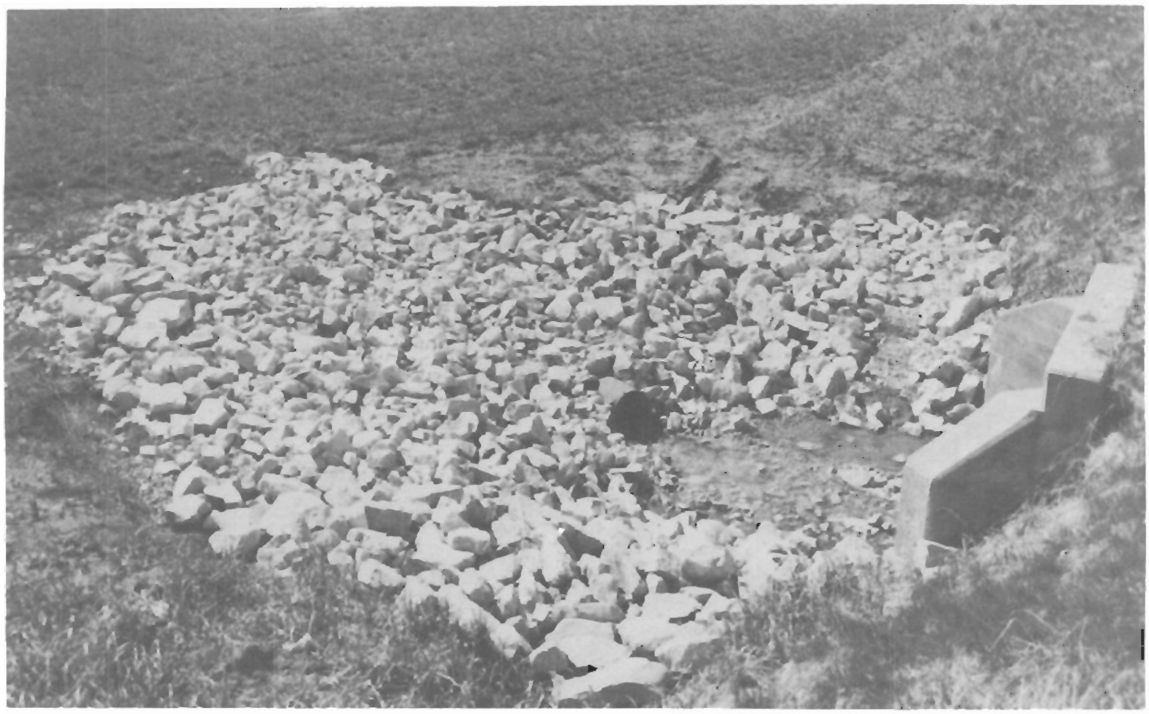

Figure 8.—Properly constructed drainage outlets prevent soil erosion. This system drains an area of Pewamo silty clay loam.

Figure 9.—Seepage in the glacial till underlying a Cardington soil causes slippage where the till is exposed on a relatively steep embankment.

Figure 10.—A seasonal high water table in areas of Luray soils and Bono soils is a severe limitation for dwellings with basements.

Figure 11.—Flooding in spring is a severe limitation to most uses of the Lobdell soil in the foreground. The house in the background is on Chili loam.

Figure 12.—Open ditches are commonly used to provide surface drainage and outlets for subsurface drainage. This ditch drains areas of Bono soils and Luray soils.

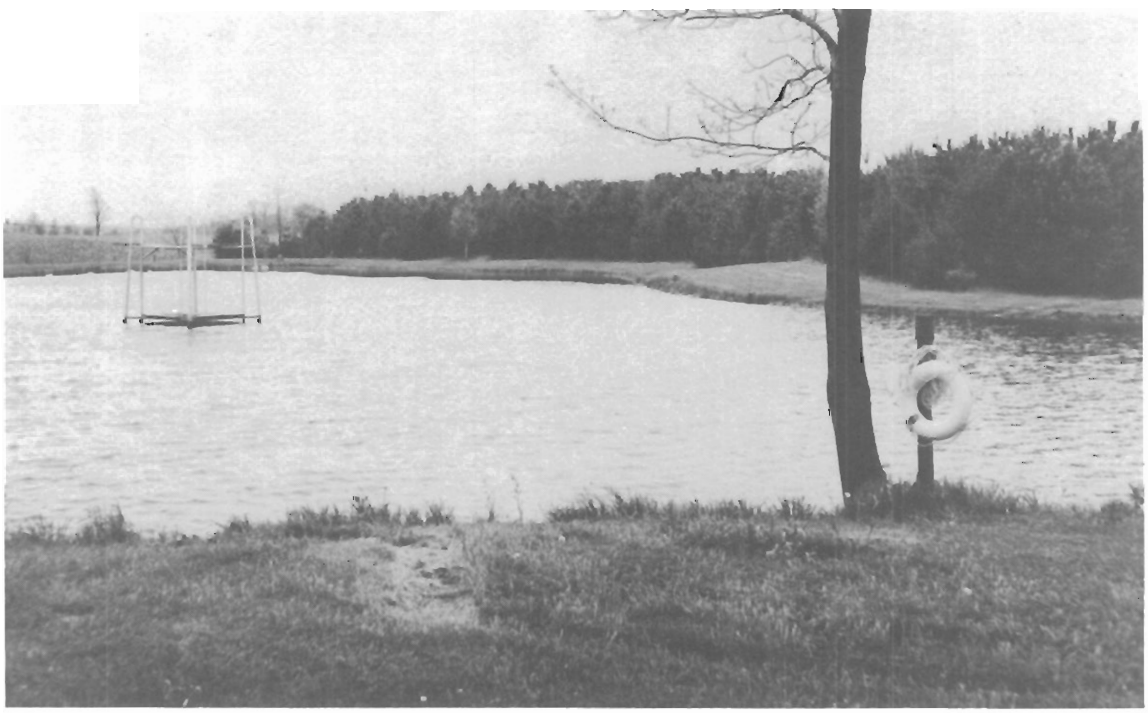

Figure 13.—A farm pond used for recreation on Marengo and Alexandria soils. Sites that are suited to ponds are numerous in Crawford County.