

# Physical Land Conditions

## in Muskingum and Guernsey Counties Ohio

by

C. L. WHITEFORD  
Associate Soil Scientist

A. H. PASCHALL  
Senior Soil Scientist  
and

E. C. SEASE  
Assistant Soil Technologist

5

Soil Conservation Surveys Division, Soil Conservation Service

Field survey by A. H. Paschall, E. C. Sease, H. H. Morse,  
D. C. Maxwell, and party

Issued 1911

### CONTENTS

	Page
Introduction .....	1
Using the land in Muskingum and Guernsey Counties .....	2
<i>Land-capability classes</i> .....	2
<i>Selecting uses, practices, and measures to fit the land</i> .....	5
<i>An example of conservation farming</i> .....	22
<i>Results and significance of the physical land inventory</i> .....	25
Physical features and drainage .....	32
Native vegetation .....	32
Economic development .....	33
Climate .....	34
Types of farming and land use .....	34
The soil conservation survey .....	36
<i>Soils</i> .....	36
<i>Slopes</i> .....	40
<i>Land use</i> .....	41
<i>Erosion</i> .....	43
<i>Relation of erosion to other factors</i> .....	44
Summary .....	46

UNITED STATES DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE • WASHINGTON

For sale by the Superintendent of Documents, Washington  
Price 35 cents

## Introduction

TEN THOUSAND ACRES suitable for cultivation ready to produce crops in Muskingum County, Ohio, were idle land in 1935—nearly half as much land in Guernsey County was suitable for cultivation but not in use. These facts apply to pre-war farming in the two counties. The land may be more fully occupied at the time this bulletin is written, in the spring of 1943.

But wartime production of corn, soybeans, and other needed crops will encourage soil erosion. Already 9 percent of the cropland in Muskingum County and 23 percent in Guernsey County have been severely damaged. This severely eroded land has lost at least three-fourths of the original topsoil, and much of it is badly gullied. A large part of it will give more returns if it is used for pasture or woodland rather than for crops.

More than half the cropland is moderately eroded. This means that it is subject to soil erosion and is approaching the danger point—the point where it must be added to the acres unsuitable for cultivation. It is still good land, but only complete and intensive soil-saving practices will keep it so.

Soil erosion was noticed by keen observers long ago. In 1878, Stevenson, writing on the geology of Guernsey County called attention to the formation of deep gullies and to the wasteful operation of planting corn on steep hillsides and thin soils.<sup>1</sup> He wrote:

In some localities it [the soil] affords barely hold for grasses on the hillsides, and during heavy rains is washed out, forming deep gullies, which continue to increase in size, notwithstanding heaps of logs and brush thrown in to impede the erosion. Little of the land remains uncultivated and even the hillsides are put in corn—a wasteful operation where they are so steep and the soil so thin.

Most of the farmers did not realize these losses, however, or did not know how to bring them under control. Many farm boundaries were laid out along or parallel to section lines. It was naturally more convenient to lay out fields in the same direction as the property lines and "square farming" was carried out on nearly all the rounded slopes. Figure 1 shows the general topography of the hilly land and the square-farming pattern. Crop rows were laid out so that many of them ran up and down slopes too steep to be cultivated. These crop rows afforded regular channels for run-off waters. A few farmers strip-cropped their fields or at least plowed across the slope, but the majority plowed parallel to the fences regardless of slope.

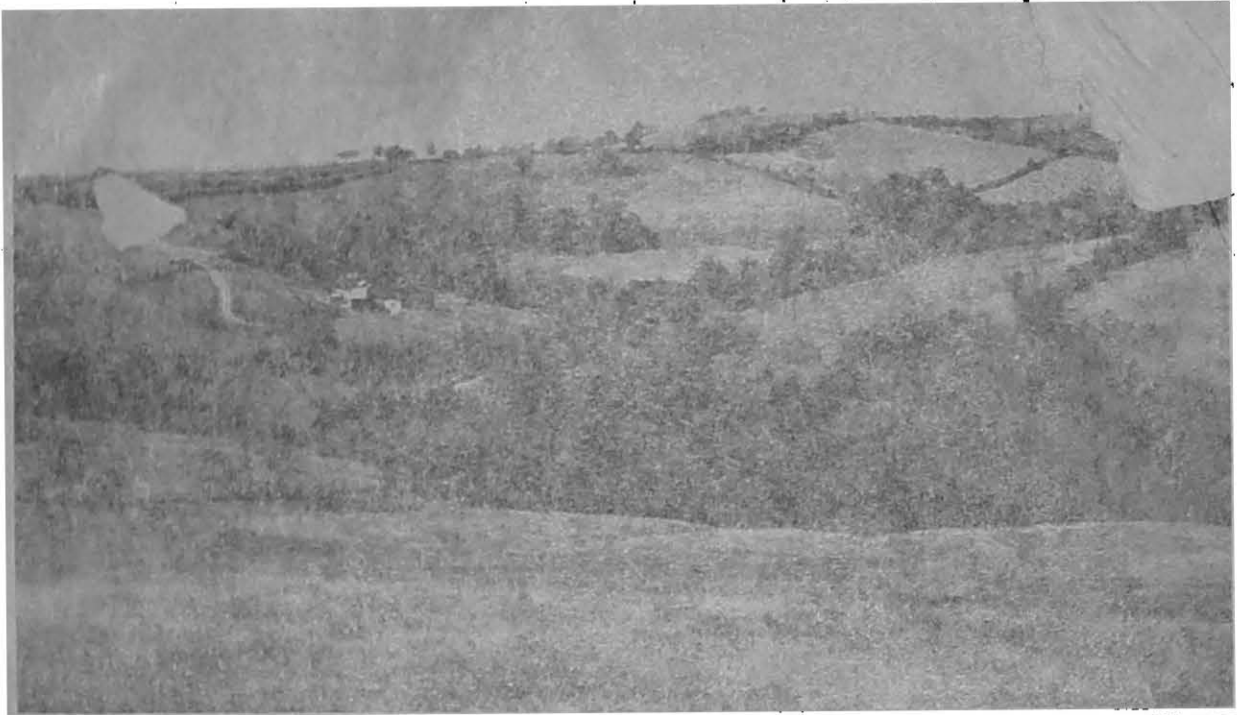
<sup>1</sup> STEVENSON, J. J. REPORT ON THE GEOLOGY OF GUERNSEY COUNTY, NORTH OF THE CENTRAL OHIO RAILROAD. Ohio Geol. Survey Bul. 3: 219-236. 1878.

The efforts of most of the farmers were directed toward the production of grain for sale or feed. They continued cropping to corn and wheat until the fields became unproductive and then turned them into pasture, with little liming or fertilizing. During World War I when grain prices were high, many pastures were replowed for grain and then later seeded to hay, after which they reverted to pasture. Livestock have been allowed to run over pastures early in the spring before the grasses attained a good growth and too late in the fall to permit recovery for good winter cover. Woodlands have been grazed and seedlings, understory, and leaf litter destroyed, preventing natural reproduction and exposing the soil to erosion. As a result the land in this section of Ohio has been more and more denuded of topsoil. Some of it has been abandoned and a great deal has been made less productive by active soil erosion.

Since 1932 the United States Department of Agriculture has carried on a large amount of work to study and control erosion in this and other sections of Ohio. A soil-erosion experiment station was established at Zanesville in 1932 on land provided by the State agricultural experiment station. Soil conservation demonstrations were begun in 1934 and 1935 near Zanesville, Hamilton, Wooster, Mount Vernon, and Cambridge. Farmers who agreed to put complete conservation plans into effect on their farms as rapidly as possible signed 5-year cooperative agreements with the Federal Government.

The Ohio soil conservation district law of 1941 enables any group of farmers to obtain technical help in conserving their soils. Seventy-five or more landowners in one locality may petition for the formation of a self-governing soil conservation district. After the district is fully organized, its governing body, which consists of farmer-elected supervisors, may request and receive technical assistance from the various public and private agencies, particularly the United States Department of Agriculture, in formulating and carrying out a program of good land use and soil-erosion control. The farmers of Guernsey County organized a district and elected supervisors in 1943.

Part of the technical work done in assisting a soil conservation district and also in carrying on the earlier demonstration projects is the making of a soil conservation survey. This is a detailed study, recorded on a map, of the soil types, slopes, kinds and degrees of soil erosion, and the present land use. It gives the information needed for classifying



OH-50015

Figure 1.—Most of the farms have some sloping land. Many fields have boundaries parallel to section lines.

land capability and the physical basis for farm conservation plans.

This bulletin reports the results of the detailed soil conservation survey of Muskingum County, in which the Salt Creek demonstration project lies, and of Guernsey County (fig. 2). On the basis of the physical survey, the land was classified according to its capability for use. Recommendations are given for the use and management of the different land-capability classes. The

bulletin also includes a brief account of the physical features and agriculture of the two counties, and a technical discussion of the survey and the facts it revealed.

The maps that accompany the bulletin are reproduced on the scale of 4 inches to the mile. They show land-capability classes in color; soil, slope, and erosion boundaries and symbols in brown; present land use in gray; drainage in blue; and roads, township and section lines, and other cultural features in black. The complete map of the 2 counties comprises 128 sheets, identified by an index. One sample sheet and the index are contained in each copy of the bulletin. Interested farmers and landowners may obtain copies of the sheets covering their farms from the soil conservation district office or from the county agricultural agents.



Figure 2.—Sketch map showing the location of Muskingum and Guernsey Counties, Ohio.

## Using the Land in Muskingum and Guernsey Counties

### Land-Capability Classes

IN PLANNING FOR MAXIMUM PRODUCTION of needed crops, whether by States, counties, or individual farms, it is essential to know the physical capabilities and limitations of the land. Some soils are too shallow and stony for profitable cropping, or they occur on slopes too steep to be cultivated without serious loss of soil. Some more moderately

are already so seriously damaged that their use and production are even now extremely limited. They are too poorly drained to be used locally for cropland. Thus, the physical factors, soil type, slope, and degree and extent of erosion, affect the suitability of any tract of land for different agricultural uses—that is, its capability.

Inasmuch as some land suitable for cultivation may now be in some other use and it may not suit the farmer's likes, convenience, or type of farming to put it into cultivation, economic and social factors must be considered in making or recommending changes in land use. But the physical features set the limitations on the intensity with which a tract of land may be used.

The appraisal of these physical factors in Muskingum and Guernsey Counties, Ohio, their relation to land capability, and the present use of the land are briefly summarized here. They are discussed in more detail on pages 36-46.

Soils were classified and mapped in 60 soil types, members of 37 soil series and 2 miscellaneous land types. They have been arranged in 8 groups according to their location on uplands, bottom lands, and second bottoms, and according to similarity of appearance, response to management, and erodibility. The 8 groups are:

1. Shallow soils developed on sandstone and shale or cherty limestone. These are the common hill-land soils of the two counties and are the most extensive of all the soils.
2. Soils with heavy clay subsoils developed on shale and sandstone. The heavy subsoils make the soils hard to cultivate and also retard infiltration of water.
3. Deep soils developed on sandstone and shale.
  - a. Well-drained on shale and sandstone.
  - b. Well-drained on sandstone and shale. These are the best agricultural soils of the uplands.
  - c. Imperfectly drained on sandstone and shale. Supplementary drainage is necessary for high yields.
4. Shallow soils developed on interbedded limestone, sandstone, and shale. These are the best pasture soils of the uplands.
5. Soils on terraces.
  - a. Well-drained. These are excellent general-farming and truck-crop soils.
  - b. Imperfectly drained. Supplemental drainage is generally necessary for high crop yields.
6. Poorly drained soils on terraces and uplands. These are too wet for regular cultivation and are best used for hay or pasture.
7. Alluvial soils.
  - a. Well-drained. These are probably the most productive soils in the two counties, but not all the areas are large enough to be cultivated.
  - b. Imperfectly drained. Supplemental drainage is usually necessary for high crop yields.

c. Poorly drained. Pasture or woodland is generally the best use for these less productive and acid soils.

8. Miscellaneous soils not suitable for cultivation. These stony or rocky soils occur on the steepest slopes and should be kept under forest or good sod cover.

Slope affects the rate of runoff of water falling on the surface of the land and, thus, the susceptibility of any area to erosion. Slope also affects the drainage of water within the soil layers. Moreover, gentle slopes may be farmed with any type of farm machinery, whereas steep slopes are not suited to the use of certain machines. Slope classes are chosen to give an expression of this factor as it affects land capability. Other factors, such as stoniness, poor drainage, or advanced erosion, may limit the use of some gentle and moderate slopes. Classes were designated in mapping by the letters A, B, C, and D. In this survey, slopes with a fall of less than 5 feet in 100 feet, or 5 percent, are A slopes. On all soils except those in group 4, B slopes are from 5 to 20 percent; C, 20 to 30 percent; and D, 30 percent or more. Limits for the B, C, and D classes for the soils in group 4 are B slopes, 5 to 25 percent; C, 25 to 40 percent; and D, 40 percent or more.

The degree to which soil erosion has advanced greatly affects the capability of the land for future use. Thirty-five classes of erosion indicating various degrees of sheet erosion, frequency and depth of gullying, and the occurrence and depth of slips or landslides were mapped. These classes were grouped for certain kinds of analysis according to the scheme shown in table 12, page 44, into five groups: No apparent, slight, moderate, severe, and very severe erosion.

Present land use does not directly influence the capability of the land for permanent use, but it must be considered in developing management plans for the land. Present land use was designated as cropland, idle land, pasture, woodland, and farmyards and urban areas.

Although each of the physical features of the land must be carefully considered in planning for proper cropping, maximum production, erosion control, and correct land treatment, they can be grouped into a few simple, standardized land-capability classes. These classes enable farmers and other land planners to select lands on which to grow cultivated crops, and to determine those lands which are not suitable for cultivation but which can be safely and profitably used for pasture or woodland. They also distinguish land on which only the ordinary good farming practices suitable to the section are necessary from land on which special soil-

saving and soil-managing practices of varying intensities must be used.

Eight general land-capability classes are recognized in the United States, seven of which occur in Muskingum and Guernsey Counties. Three classes are suitable for

cultivation if the proper land and conservation practices are used. A fourth class is suitable for cultivation only. The remaining four are not suitable for the production of crops that require tillage, but three of them

TABLE 1.—Soils, slope classes, and erosion classes making up each land-capability class

Soil group and series	Slope <sup>1</sup> and erosion <sup>2</sup> characterizing land-capability class—					
	I (green) <sup>3</sup>	II (yellow) <sup>3</sup>	III (red) <sup>4</sup>	IV (blue) <sup>5</sup>	VI (orange) <sup>6</sup>	VII (brown) <sup>7</sup>
1. Shallow soils developed on sandstone and shale or cherty limestone. Frankstown. Muskingum loam and silt loams.	A: 1.....	A: 2, 27.....	A: 3, 37..... B: 1, 2, 27, 2②, 3, 37, 3③, 6.	A: 38, 4..... B: 28, 2②, 38, 4, 47, 4④, 6V, 67. C: 1, 2, 27, 2③.	B: 3⑤, 48, 4⑥, 6⑦, 68, 6⑧. C: 3, 37, 3②, 6, 6V, 67.	B: 5, 57, 5⑨, 58, 5⑩, 9. C: 28, 38, 3④, 4, 47, 4④, 48, 4⑥, 5, 57, 5⑨, 58, 5⑩, 6②, 68, 6⑧, 9. All D slopes.
2. Soils with heavy clay subsoils, developed on shale and sandstone: Effort. Meigs (Muskingum-Upsbur). Rarden. Upsbur.	A: 1.....	A: 2.....	A: 3..... B: 1, 2, 3, 37, 3③.	A: 1, 47..... B: 4, 47, 4④, 6. C: 1, 2, 27.	B: 38, 3⑤, 48, 4⑥, 6V, 67, 6⑧, 68, 6⑨. C: 3, 37, 3②, 6, 6V, 67.	B: 5, 9. C: 2②, 38, 3④, 4, 47, 4④, 48, 4⑥, 57, 58, 6⑦, 68, 6⑧, 9. All D slopes.
3. Deep soils developed on sandstone and shale: a. Well-drained, on shale and sandstone: Coolville. Guernsey. Keene.	A: 1.....	A: 2, 3 B: 1, 2.	B: 3, 37, 3③, 38.....	B: 4, 47, 4④, 18, 67.	B: 4②, 6③..... C: 3②, 4.	B: 5, 57, 5⑨, 9. C: 4⑤, 5, 58, 5⑩.
b. Well-drained, on sandstone and shale: Ilanover. Wellston. Zanesville.	A: 1.....	A: 2, 3..... B: 1, 2, 27, 27V.	A: 5..... B: 3, 37, 37V, 38.	B: 38V, 4, 47, 47V, 48, 6, 6V, 67. C: 1, 2.	B: 48V, 67V..... C: 3, 37V, 4, 48, 6V.	B: 5, 57, 58V, 9. C: 5, 9. All D slopes.
c. Imperfectly drained Tillet.		A: 1, 2, 27 B: 1, 2.	A: 28, 3..... B: 3, 37.	A: 38..... B: 38, 4.	B: 48, 6②.....	B: 5, 9.
4. Shallow soils developed on interbedded limestone, sandstone, and shale: Belmont. Brooke. Westmoreland.	A: 1.....	A: 2.....	A: 3, 37..... B: 1, 2, 27, 3, 37, 3③.	B: 28, 38, 4, 47, 4④. C: 1, 2.	B: 2②, 3③, 48, 4⑥, 6, 6V, 67, 6③, 68, 6④. C: 3, 37, 3②, 6, 6V, 67.	B: 5, 57, 5⑨, 5⑩, 9. C: 2②, 38, 3④, 4, 47, 4④, 48, 4⑥, 5, 57, 5⑨, 58, 6②, 68, 6⑧, 9. All D slopes.
5. Soils on terraces: a. Well-drained: Chemungo. Elk. Holston. Vincent.	A: 1.....	A: 2..... B: 1, 2, 27, 27V.	A: 3, 37..... B: 3, 37, 37V.	A: 4..... B: 38, 4, 47, 6. C: 1.	B: 38V, 48, 48V..... C: 2.	B: 5, 9. C: 3, 37, 37V, 38, 4, 47, 47V, 48, 9. All D slopes.
b. Imperfectly drained: Braceville. Captina. Monongahela.		A: 1, 2..... B: 1, 2, 27.	A: 3..... B: 3, 37, 3③.	A: 4..... B: 38, 4, 17, 4④. C: 1.	B: 3⑤, 48..... C: 2.	C: 3, 3③, 4, 47, 4④, 48, 4⑥, 5, 5⑨, 58. All D slopes.
6. Poorly drained soils on uplands and terraces: Higo. Mullus. Tyler.				A: 1, 2, 3, 37, 4..... B: 1, 2, 3, 37, 3③, 4.		
7. Alluvial soils: a. Well-drained: Huntington. Chargin. Moshannon. Pope.	A: 1, 2.....	A: 3..... B: 1, 2, 3, 37, 3③.				
b. Imperfectly drained: Lindside. Lodell. Philo. Senecoville.		A: 1, 2, 3..... B: 1, 2, 27, 2②, 3.				
c. Poorly drained: Atkins. Melvin. Holly.				A: 1, 2..... B: 1, 2, 3, 48, 4④.		
8. Miscellaneous soils not suitable for cultivation: Muskingum stony loam and stony silt loam. Stony land, Muskingum soil material.					A: 1, 2, 3..... B: 1, 2, 3, 37, 3③.	B: 38, 3③, 4, 47, 4④, 48, 4⑥, 6, 67, 9. All C and D slopes.

<sup>1</sup> On Belmont, Brooke, and Westmoreland series in group 4: A slopes, less than 5 percent; B, 5-25; C, 25-40; and D, 40 percent and over. On all other series: A slopes, less than 5 percent; B, 5-25; C, 25-30; and D, 30 percent and over.

<sup>2</sup> Erosion symbols are explained in detail on p. 43 and in the legend on the maps accompanying this bulletin. 2, 3, 4, and 5 indicate progressive degree of sheet erosion; 7, 8, and 9 occasional, frequent, and very frequent or large gullies, respectively; ①, gullies too deep to be crossed with tillage implements; V, deep gullies that have penetrated into a friable parent material; 1, no apparent erosion; 6, slips, or landslides, that have dropped less than 3 feet; and 6V, slips, or landslides, that have dropped 3 feet or more.

<sup>3</sup> Color distinguishing class on the maps accompanying this bulletin.

suitable for the production of permanent vegetation for grazing or woodland use. The eighth class is of such a nature that its usual disposition lies in abandonment to nature, although there is some opportunity for development of wildlife and recreational areas. The eight classes are:

#### Suitable for Cultivation

- I. Land suitable for cultivation without special practices.
- II. Land suitable for cultivation with one or more simple practices.
- III. Land suitable for cultivation with intensive practices.

#### Suitable for Occasional or Limited Cultivation

- IV. Land suitable for occasional cultivation with limited use and intensive practices. Its chief use is for long-term hay or permanent pasture.

#### Not Suitable for Cultivation but Suitable for Grazing or Woodland

- V. Land suitable for grazing or woodland use with no special restrictions. No land of this class occurs in Muskingum and Guernsey Counties.
- VI. Land suitable for grazing or woodland use with moderate restrictions. In Muskingum and Guernsey Counties this land is recommended chiefly for permanent pasture.
- VII. Land suitable for grazing or woodland use with severe restrictions. In Muskingum and Guernsey Counties this land is recommended chiefly for woodland.

#### Not Suitable for Productive Vegetation

- VIII. In Muskingum and Guernsey Counties this class of land consists of strip-mining areas, dumps, and quarries.

The manner in which the physical factors affect the capability of the land in Muskingum and Guernsey Counties is shown in table 1. Soil series within each soil group are listed as well as the different slope and erosion classes. This table is based on observations of many different soils and slopes in cultivated fields, pastures, and woodlands.

#### Selecting Uses, Practices, and Measures to Fit the Land

The physical inventory and the classification of land capability furnish a physical basis upon which a farmer may plan his farm for maximum production and at the same time maintain it for continued safe use. He knows that land in classes VI and VII should be used for pasture and woodland. He knows also that he should use land in class IV primarily for long-term hay or pasture but that he may grow a cultivated or small-grain crop once in 5 or 6 years on this land if it needs reseeding or if additional cropland is needed. The proportion of land in classes I, II, and III to be devoted to

crops is dependent largely on his kind of farming, his needs, the location of his lands, and his own preferences. He may wish to maintain a great part of even these lands in hay or pasture or his needs may be such that he must use nearly all of them for the growing of crops.

Wide choices are available in the practices applicable to each class of land. The most desirable choice depends largely on the type of farming and the farmer's individual needs and preferences. Table 2 summarizes the farming and conservation practices recommended for each land-capability class in Muskingum and Guernsey Counties. Suitable rotations, soil treatments, and conservation practices are given for the different soil groups within each class as these vary according to the soil. Less intensive rotations should be substituted if the crop requirements permit.

#### CLASS I LAND

Class I land, shown on the map in green, is suitable for cultivation without any special practices. Class I land meets all the following requirements: It is nearly level and therefore not subject to erosion if an intertilled crop, such as corn, is grown; it is physically suitable for cultivation so that the use of farm machinery is not hindered by stones or rock ledges; it is well enough drained for crops to be grown and good yields obtained without using supplementary drainage; it is not subject to frequent destructive overflow; it retains enough moisture and plant nutrients to favor continued production of at least moderate yields of adapted crops. Although no special erosion-control or drainage measures are needed on class I land, numerous accepted practices of soil management, such as liming, fertilizing, manuring, and any measures necessary to control insect pests, will be desirable and sometimes even necessary for good yields. There are 19,941 acres of land meeting class I requirements in Muskingum County and 4,068 acres in Guernsey County, amounting to 4.8 percent of Muskingum County and 1.3 percent of Guernsey County.

None of the class I land is on a slope of more than 5 percent. None of the upland areas shows any apparent erosion. The bottom lands receive annual deposits of material washed from the uplands, but not to such an extent or of such a character as to hinder their regular use for cropland.

Most of the class I land in these counties occurs on the well-drained level first bottoms (soils of the Huntington, Chagrin, Moshan-

non, and Pope series), which receive flood sediments almost every year. They can support continuous cultivation to row crops if attention is given to the maintenance of the soil organic matter. If corn is grown continuously, crop residues must be returned, barnyard manure applied, or a green-manure crop grown and turned under. Rye can be used for green manure annually and sweet-clover once every 2 or 3 years. Continuous cropping to corn is not recommended, however, except where an occasional winter flood makes it impracticable to grow winter grain. Rotations consisting of a row crop, small grain, and 1 or 2 years of hay are much more effective as a means of adding organic matter and keeping up the general productivity of the soils.

The fertilizer requirements for these bottom-land soils are usually low because plant nutrients are added in the periodic overflows. The Huntington, Chagrin, and Moshannon soils, derived from wash from uplands that contain some limestone, are neutral or only slightly acid and do not usually require lime. The Pore soils, on the other hand, are acid and require lime for the growth of legumes.

The remaining class I lands are uneroded A slopes of some of the terrace and upland soils. These are only moderately fertile soils and require careful selection of rotations and the use of lime, manure, and fertilizers. The most desirable rotation consists of corn, wheat, and 2 years of hay. Another rotation that may be used successfully is one of corn, soybeans, wheat, and hay. A 3-year rotation of corn, wheat, and hay may also be used if the soils are limed and fertilized heavily for good hay stands and for maintenance of the fertility balance. Phosphate is especially needed.

Both lime and fertilizer should be applied on all lands according to test and to the recommendations of the Ohio Agricultural Experiment Station and Extension Service. The Ohio Extension Service carries on a soil-testing service for farmers, who should get in touch with their county agent for information regarding the collection of soil samples and their transmittal for testing. Information on lime and fertilizer recommendations for the different soils and crops may also be obtained from numerous bulletins. Suggested bulletins are Ohio Agricultural Extension Service bulletin 136, Fertilizing Field Crops in Ohio, and bulletin 177, Liming Ohio Soils.

#### CLASS II LAND

Class II land, shown on the map in yellow, is suitable for cultivation but requires one

or more simple practices to insure its continued safe use. Sloping class II land needs one or more of such practices as contour cultivation, buffer strips, wide strip cropping, and the diversion of water from erodible land. Imperfectly drained class II land requires maintenance of drainage ditches or simple drainage, such as one or two tile lines or open ditches, together with careful selection of crops. There are 56,049 acres of class II land in Muskingum County, 14 percent of the county, and 35,632 acres in Guernsey County, 11 percent of the county.

None of the class II land on the shallow upland soils (Muskingum, Meigs, Upshur) occurs on slopes greater than 5 percent or has been more than slightly eroded. Class II land on the deeper well-drained upland and terrace soils (Guernsey, Wellston, Zanesville, Holston, Chenango) may be on both A and B slopes, but none of these areas has been more than slightly eroded. Class II land on the well-drained alluvial soils (Huntington, Chagrin, Pope) consists of A slopes with moderate erosion and B slopes with no apparent, slight, or moderate erosion. A and B slopes with no apparent or slight erosion on the imperfectly drained upland, terrace, and alluvial soils (Tilsit, Monongahela, Captina, Lindside, Lobdell, Philo) are in class II. None of these imperfectly drained soils meets the requirements of class I land because some simple drainage measure, such as open ditches or in low spots tile drains, is necessary for good yields.

The class II areas of the shallow upland soils (Muskingum, Frankstown, Meigs, Upshur, Westmoreland, Belmont) should be farmed in 4- or 5-year rotations of corn, wheat, and 2 or 3 years of hay. Usually a 4-year rotation is long enough to control erosion on the gentle slopes if supplemented by one or more simple erosion-control measures, such as contour cultivation, contour buffer strips, and sod waterways.

Contour cultivation consists of plowing and cultivating on the level around the slope rather than uphill and downhill as has been the too common practice in the past. This ridging of the land around the slope retards the flow of water down the slope, thus reducing erosion. Small grains should be seeded on the contour since level drill furrows tend to hold water. The water retained also benefits the grasses and legumes seeded in the small grain for the succeeding hay crop. In dry seasons this additional moisture may mean the difference between success and failure of hay seedings.

The use of contour buffer strips in conjunction with contour cultivation is a

TABLE 2.—Farming and conservation practices recommended, according to land capability

Land-capability class	Soil group, slope, and erosion	Practices for—				
		Annual crops and hay land			Pasture <sup>2</sup>	Woodland
		Rotations <sup>1</sup>	Treatments <sup>1</sup>	Supporting practices		
I (green) <sup>1</sup>	Groups 1, 2, 3a, 3b, 4, and 5a: A slopes, no apparent erosion. Chiefly well-drained terrace soils (group 5a, Chenango and Holston) and shallow upland soils (group 1, Muskingum).	1. R-G-H-H. 2. R-G-H. 3. R-SB-G-H.	Lime and fertilizer according to test; return crop residues; manure if available.	None.	Controlled grazing; mowing; lime and fertilizer according to test at least once every 4 years.	Existing woodlands: Exclusion of livestock; protection from fire; gradual removal of grapevines, wolf trees, and weed trees; selective cutting of mature trees; interplanting with desirable species in large openings where ground is hard.
	Group 7a: A slopes, no apparent and slight erosion. Well-drained alluvial soils (Huntington, Chagrin, Moshannon, and Pope).	1. R-G-H. 2. R-G-H-H. 3. R-G (GM). 4. R-R-R.	Lime and fertilizer according to test.  Lime and fertilizer according to test; return crop residues; barnyard manure or green-manure crop.	do. do.	do. do.	Do. Do.
II (yellow) <sup>1</sup>	Groups 1, 2, and 4: Shallow upland soils. A slopes, slight erosion. Chiefly Muskingum (group 1), Meigs and Rarden (group 2), and Westmoreland (group 4).	1. R-G-H-H. 2. R-G-H-H-H.	Lime and fertilizer according to test; return crop residues; manure if available.	Contour cultivation; field stripping; contour buffer strips; sod waterways.	Same as class I. In addition, slope, lime, fertilize, and seed any occasional gullies; divert water from any actively cutting gullies by herringbone system of furrows or a small diversion.	Do.
	Groups 3a, 3b, and 5a: Well-drained deep upland and terrace soils; A slopes, slight and moderate erosion; B slopes, no apparent and slight erosion. Chiefly Wellston and Zanesville (group 3b) and Holston and Chenango (group 5a).	1. R-G-H-H. 2. R-G-H-H-II. 3. R-G-H.	do.	On A slopes, contour cultivation; contour buffer strips; sod waterways. On B slopes, contour strip cropping; sod waterways; diversions on long slopes; on long slopes under 10 percent, broad-base terraces may be used on the friable Wellston, Zanesville, and Holston soils.	do.	Do.
	Group 7a: Well-drained alluvial soils; A slopes, moderate erosion; B slopes, all erosion classes (Huntington, Chagrin Moshannon, and Pope).	1. R-G-H-H. 2. R-G-H.	Lime and fertilizer according to test; return crop residues.	Contour cultivation; sod waterways; diversions where needed at base of adjacent upland slopes to divert water into sod waterways.	do.	Do.
	Groups 3c and 5b: Imperfectly drained deep upland and terrace soils; A and B slopes, no apparent and slight erosion. Chiefly Tilsit (group 3c) and Monongahela (group 5b).	1. R-G-H-H. 2. R-G-H-H-H.	Lime and fertilizer according to test; return crop residues; green-manure crops.	Tile or open-ditch drainage on A slopes. Cultivation across slope with slight grade to aid in drainage; buffer strips; sod waterways on B slopes.	Controlled grazing; mowing; lime and fertilizer according to test.	Do.
	Group 7b: Imperfectly drained alluvial soils; A and B slopes; no apparent, slight, and moderate erosion. (Lindside, Philo, Lobdell, and Senecaville).	1. R-G-H-H. 2. R-G-H.	do.	Tile or open-ditch drainage on A slopes; cultivation across slope with slight grade to aid in drainage on B slopes.	do.	Do.

See footnotes at end of table.



TABLE 2.—Farming and conservation practices recommended, according to land capability—Continued

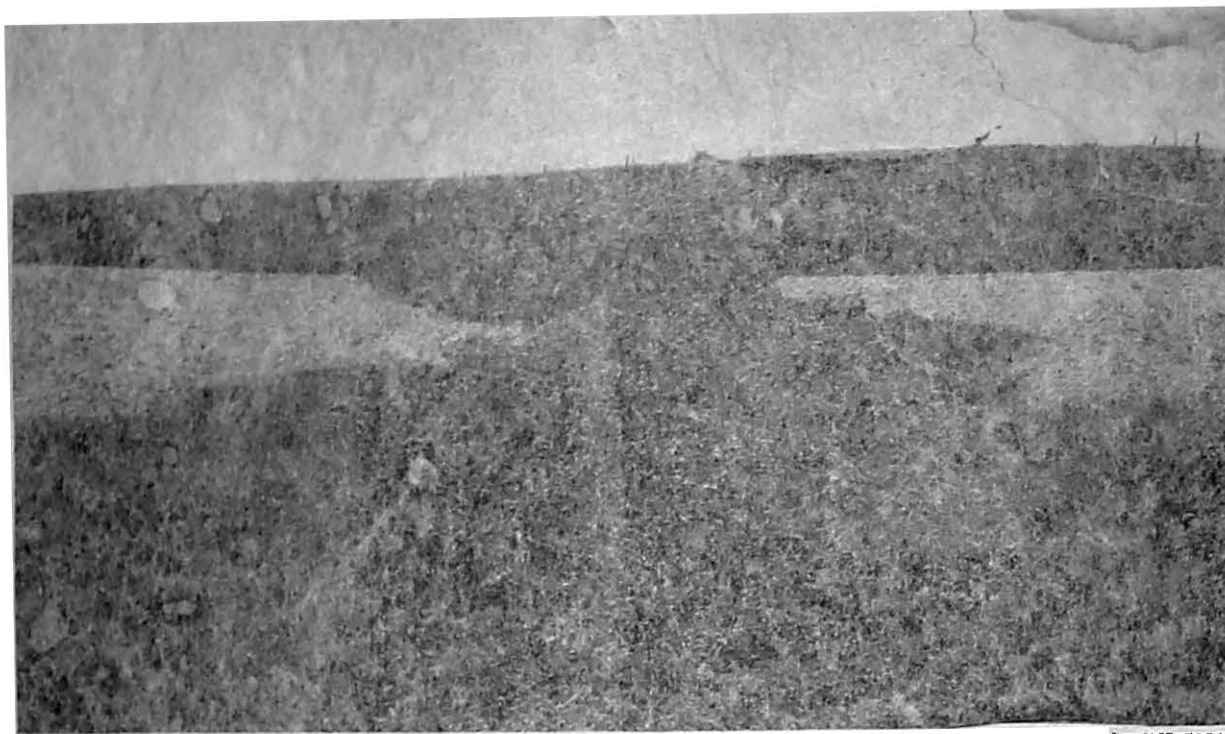
Land-capability class	Soil group, slope, and erosion	Practices for —				
		Annual crops and hay land			Pasture	Woodland
		Rotations <sup>1</sup>	Treatments <sup>1</sup>	Supporting practices		
III (red) <sup>2</sup>	Groups 1, 2, and 4: Shallow upland soils; A slopes, moderate erosion; B slopes, no apparent, slight, and moderate erosion. Chiefly Muskingum (group 1), Meigs (group 2), Belmont and Westmoreland (group 4).	1. R-G-H-H 2. R-G-H-H-H-H.	Lime and fertilizer according to test; return crop residues; manure.	Contour strip cropping, width and spacing of strips adjusted to slope; diversions about every fourth strip on slopes over 300 feet in length if suitable outlets can be provided; soil waterways.	Controlled grazing; mowing; lime and fertilizer according to test; slope, lime, fertilize, and seed gullies or plant black locust in gullies; divert water from actively cutting gullies by herring-bone system of furrows or a small diversion; renew by plowing in strips on the contour.	Same as classes I and II for established woodlands. New field plantings: White and red pines on slightly or moderately eroded sites on soils in groups 1 and 2; black locust or white and red pines on similar sites on soils of group 4; preparation of site by scalping or contour furrowing. Gully plantings: black locust and red, white, pitch, and shortleaf pines.
	Groups 3a, 3b, and 5a: Well-drained deep upland and terrace soils; A and B slopes, moderate erosion. Chiefly Wellston and Zanesville (group 3b) and Holston (group 5a).	1. R-G-H-H 2. R-G-H-H-H-H. 3. R-G-H.	do.	Contour strip cropping, width and spacing of strips adjusted to slope; terraces on slopes less than 10 percent on Wellston, Zanesville, and Holston soils; on long slopes and in conjunction with strip cropping, diversions in every fourth strip or terraces on upper part of slope; soil waterways.	do.	Same as classes I and II for established woodlands. New field plantings: White and red pines on moderate eroded sites, preparation of site by scalping or contour furrowing. Occasional gully plantings: black locust and red, white, pitch, and shortleaf pines.
	Groups 3c and 5b: Imperfectly drained deep upland and terrace soils; A and B slopes, moderate erosion. Chiefly Tilsit (group 3c) and Monongahela and Captina (group 5b).	1. R-G-H-H 2. R-G-H.	do.	Same as for groups 3a, 3b, and 5a. Terraces to be built on drainage grade; tile drains in seep spots.	do.	Do.
IV (blue) <sup>1</sup>	Groups 1, 2, 3a, 3b, 4, and 5a: Well-drained upland and terrace soils; A and B slopes, severe erosion; C slopes, slight erosion. Chiefly Muskingum (group 1), Meigs (group 2), and Belmont and Westmoreland (group 4).	1. Long-term hay to be renewed by small grain or row crop and small grain.	Lime and fertilizer according to test.	Renew hay by plowing in narrow strips on contour; maintain two-thirds of field in grass at all times; field diversions on slopes over 300 feet in length.	Controlled grazing; mowing; lime and fertilizer according to test in a regular schedule of application; divert water from actively cutting gullies by herring-bone system of furrows or a diversion; slope, seed, and mulch gullies; renew by plowing in narrow strips on contour or by disking; maintain at least two-thirds of field in grass at all times.	Same as classes I, II, and III for established woodlands. New field plantings: White and red pines on slightly or moderately eroded sites; shortleaf, Virginia, pitch, and Scotch pines on severely eroded sites; black locust on soils of group 4 only; preparation of site by scalping or contour furrowing; mulching. Gully plantings: Red, white, pitch, and shortleaf pines on dry ridges; black locust on lower sides and bottoms.
	Groups 3c and 5b: Imperfectly drained upland and terrace soils; A and B slopes, severe erosion; C slopes, no apparent and slight erosion. Chiefly Tilsit, Monongahela, and Captina.	1. Long-term hay to be renewed by small grain or row crop and small grain.	do.	In renewing hay stands plow in narrow lands.	do.	Do.

VI (orange) <sup>1</sup>	<p>Groups 6 and 7c: Poorly drained upland, terrace and alluvial soils; A and B slopes; all erosion classes. Chiefly Tyler, Atkins, Holly, and Melvin.</p> <p>Groups 1, 2, and 4: Shallow well-drained upland soils; B slopes, very severe erosion; C slopes, moderate erosion. Muskingum and Frankstown (group 1), Meigs (group 7), Belmont and Westmoreland (group 4).</p> <p>Groups 3a, 3b, and 3c: Deep well-drained and imperfectly drained upland soils; B slopes, very severe erosion; C slopes, moderate and severe erosion. Chiefly Wellston and Zanesville (group 3b), Tilsit (group 3c).</p> <p>Groups 5a and 5b: Terrace soils; B slopes, very severe erosion; C slopes, slight and moderate erosion. Holston and Monongahela.</p> <p>Group 8: Stony soils; A and B slopes, slight and moderate erosion.</p>	<p>1. Long-term hay to be renewed by small grain. (Hay stands on Blago silty clay loam in group 6 may be removed by row crop and small grain if soil is drained.)</p> <p>Convert to pasture.....</p> <p>Convert to woodland.....</p> <p>None.....</p>	<p>do.....</p> <p>do.....</p> <p>None.....</p> <p>None.....</p> <p>None.....</p>	<p>Controlled grazing; mowing; lime and fertilizer according to test in regular schedule of application.</p> <p>Controlled grazing; mowing; lime and fertilizer according to test in a regular schedule of application; no plowing; disk if necessary.</p> <p>Divert water from actively cutting gullies by herringbone system of furrows or diversions; slope, lime, fertilize, and seed gullies or plant black locust in deep gullies.</p> <p>None. (If necessary to maintain in grass, treat as for class VI, but grazing must be very carefully controlled with rono in the early spring. Very intensive fertilization required.)</p> <p>None.....</p>	<p>Do.</p> <p>Do.</p> <p>Same as for class VI. Reclamation of steep and severely eroded areas requires special care.</p> <p>Not suitable at present for productive woodlands. May have considerable value for wildlife or for recreational areas. Reclamation for woodland or pasture may be justifiable in a few places.</p>
VII (brown) <sup>2</sup>	<p>Groups 1, 2, and 4: Shallow well-drained upland soils; C slopes, severe and very severe erosion; all D slopes.</p> <p>Groups 3a, 3b, and 3c: Deep well-drained and imperfectly drained upland soils; B and C slopes, all topsoil gone or destroyed by gullies; all D slopes.</p> <p>Groups 5a and 5b: Terrace soils; C slopes, severe and very severe erosion; all D slopes.</p> <p>Group 8: Stony soils; B slopes, moderate, severe, and very severe erosion; all C and D slopes.</p>	<p>Convert to woodland.....</p> <p>None.....</p>	<p>None.....</p> <p>None.....</p>	<p>None.....</p> <p>None.....</p>	<p>Same as for class VI. Reclamation of steep and severely eroded areas requires special care.</p>
VIII (purple) <sup>3</sup>	<p>Mine pits and dumps, strip-mining areas.</p>	<p>None.....</p>	<p>None.....</p>	<p>None.....</p>	<p>Not suitable at present for productive woodlands. May have considerable value for wildlife or for recreational areas. Reclamation for woodland or pasture may be justifiable in a few places.</p>

<sup>1</sup> R=row crop, usually corn; G=small grain, usually wheat; H=grass-legume hay; SB=soybeans; GM=green-manure crop, usually clover.

<sup>2</sup> Lime and fertilizer should be applied according to test and recommendations of the Ohio Agricultural Experiment Station and the Ohio Agricultural Extension Service.

<sup>3</sup> Color distinguishing class on maps accompanying this bulletin.



OH-50069

Figure 3.—This sod waterway is on one of the cooperative farms in the Salt Creek project area. It is wide enough to prevent gully-ing and to permit harvesting of the hay crop.

recommended practice on some class II land. Buffer strips are strips of close-growing hay spaced at intervals in the field. They should usually be about 12 to 14 feet wide, although they may be irregular in width in order to keep the cultivated rows in the remainder of the field on the contour. Buffer strips should be spaced at intervals of 100 feet on the nearly level land, but at intervals of 60 to 70 feet on the more rolling class II land. They are necessary only when the field is in a cultivated crop.

All waterways should be maintained in sod to prevent gullying. Many waterways in cultivated fields of this section of Ohio are gullied because of the common practice of plowing them with the rest of the field. In a few fields where waterways have been kept in sod, there has been some gullying at the junction of the sod and the plowed ground because the sod strip was too narrow. The proper width of the sod strip depends on the cross section of the draw and the size of the drainage area above it. As a rule it should be wide enough to allow for at least one round with a mowing machine (fig. 3). Where the drainage area is greater than 5 acres, the sod strips should be 15 to 20 or more feet wide.

Four- and five-year rotations are also recommended for the deep well-drained upland and terrace soils (Wellston, Zanesville, Holston, Chenango). Erosion of slightly eroded

A slopes may generally be controlled by using the 4- or 5-year rotation and one or more of the supplementary practices recommended for the shallow upland soils in class II. Two other practices that should be used on many of the B slopes of these deep soils are contour strip cropping and, in a few places, terracing. A 3-year rotation of corn, wheat, and hay may be used on fields that are protected by terraces if the fertility is adequately maintained by fertilizing and returning all crop residues. Contour strip cropping consists of alternating bands of row crops and close-growing crops. The strips are maintained on the contour. The width of the cultivated strips that may be used on class II land ranges from 100 to 125 feet, depending on the slope.

Cropland terraces, broad ridges of earth 25 to 30 feet wide, are useful on long, uniform slopes of less than 12 percent on which large amounts of water concentrate. They should be built only on deep, well-drained soils that are friable and free of stones, gravelly material, or a hard layer for at least 3 or 4 feet. Usually they are needed only on slopes longer than 200 to 250 feet and are ordinarily not recommended for slopes that can be adequately protected by other less costly measures. Although terraces may be built at regular intervals over the entire slope, a few terraces on the upper part of the slope will usually be all that are needed on most of the class II land suitable for terracing.

Terraces should be discharged into outlets in which vegetation is well established. Natural outlets, where available, are the cheapest and most satisfactory but not all fields contain drainageways sufficiently sodded to permit discharge of excess water onto the existing sod. Well-sodded pastures adjoining a terraced field may be used for outlets but the concentration of large amounts of water, even on pastures, must be avoided. New outlets should be prepared well in advance of terrace construction. A broad, shallow channel should be prepared, limed, fertilized, and manured as needed, and seeded to a mixture in which redtop and white clover predominate. The channel should be wide enough to permit mowing.

The laying out and construction of terraces requires experience and often technical assistance.<sup>2</sup> Once constructed, however, they are easy to farm with and may generally be maintained by proper plowing, whereby the soil is backfurrowed toward the terrace ridge and dead-furrowed in the terrace channel. They should be carefully inspected after heavy rains, and any breaks should be repaired immediately. All terraced fields should be cultivated on the contour.

On many long slopes over 12 percent and on long slopes of shallow soils not suited to terracing one or two diversions will be necessary to break up the slope and intercept and divert water from the lower part of the slope. A diversion differs from the ordinary cropland terrace chiefly in its steeper grade. Other differences lie in the fact that the ridge and channel of the diversion are not cultivated but are maintained in permanent vegetation and that a filter strip of permanent vegetation is maintained above the channel of the diversion. Diversions, like terraces, should discharge into well-established grassed outlets.

The class II areas of well-drained bottom land (Huntington, Moshannon, Chagrin, and Pope soils), which are slightly sloping, should be cultivated on the contour. The most intensive rotation recommended for these areas is a 3-year rotation of corn, wheat, and hay. A 4-year rotation that includes 2 years of hay, however, is more satisfactory for maintaining tilth and productivity. Water discharged from the adjacent upland slopes often causes much damage on bottom lands. A diversion at the base of the upland slope will divert this water into an established drainageway and protect the lower lying

<sup>2</sup> Further information on terracing and other erosion-control practices is contained in bulletins of the Soil Conservation Service and the Ohio Agricultural Experiment Station and Extension Service. See Ohio Agr. Col., Ext. Bui. 186, Erosion Control in Ohio Farming

land. All waterways should be maintained in grass.

The necessity for some drainage measures in order to secure regular satisfactory yields of crops on the A slopes of the imperfectly drained uplands and terrace soils (Tilsit, Monongahala, Bracoville, and Captina) places them in class II rather than in class I. Once tile or open-ditch drainage is installed these slopes may be farmed in the 4-year rotations recommended for class I land. Special supplementary drainage is seldom necessary on the B slopes of these soils, but grade cultivation, that is cultivation across the slope with a slight grade, will improve drainage. Buffer strips are needed in some places for erosion control, and all waterways should be maintained in grass.

A large part of the class II land consists of A slopes of the imperfectly drained bottomland soils (Lindsay, Philo, Lobdell, and Senecaville soils). These are not subject to erosion, but they need some supplementary drainage in order to produce satisfactory yields of field crops regularly. Tile or open-ditch drainage should be installed and 3- or 4-year rotations followed. The B slopes of these soils, also in class II, will usually not require any special supplementary drainage, but cultivation across the slope on a slight grade will protect them from erosion and also aid drainage.

All class II land should be limed and fertilized according to test and the recommendations of the experiment station and extension service. Manure should be applied where available. Turning under green-manure crops on the imperfectly drained soils will improve tilth and add organic matter. All crop residues should be plowed under.

#### CLASS III LAND

Class III land, shown on the map in red, is subject to serious erosion but can be used regularly and safely for crops if intensive conservation practices are carefully applied. Most of the class III land is moderately sloping and some of it has already undergone moderate erosion. There are 140,289 acres of land in this class in Muskingum County and 96,399 acres in Guernsey County, about a third of each county.

Class III land on the shallow upland soils (Muskingum, Meigs, Upshur, Westmoreland, Belmont) consists of B slopes with no apparent, slight, or moderate erosion and A slopes with moderate erosion. Four- and six-year rotations are recommended for these areas. These rotations should be supported by contour strip cropping, diversions where

needed, and the maintenance of all waterways in wide grassed strips. The width of the cultivated strips should be determined by the steepness of the slope, but, in general, on the class III areas of these shallow soils it should be about 85 feet. On the steeper B slopes there should be double-width strips of hay between single-width strips of corn or wheat. A 6-year rotation fits into this scheme very well. Extreme care should be taken on these class III lands in laying out the cultivated strips to insure their being on the contour. Experience in the Salt Creek demonstration project and data secured by Gerdel in studies of strip cropping<sup>3</sup> indicate that strips should not be more than 4 percent off contour if they are to be effective in controlling soil losses. Figure 4 shows strip cropping in Muskingum County.

If slopes are more than 300 feet long on these shallow soils, a diversion should be built on approximately every fourth strip to break up the length of the slope. This is usually needed only in a 4-year rotation and may not be needed in 6-year rotations in which not more than one-third of the field is in row crops or small-grain crops at any one time. Diversions should ordinarily discharge into outlets in which vegetation is well established. Many of the natural drainageways in fields of the shallow soils, however, have rock bottoms in which there is no danger of further cutting. These waterways can safely carry water discharged from diversions without further preparation. It may sometimes be necessary to prepare a grassed outlet to carry the water from the diversion to the rocky natural waterway.

If possible, diversions should not be built on areas where landslides have occurred. If a diversion must be located so that it will cross on or just above a slide, it should be constructed with sufficient grade to carry off water as rapidly as possible.

Moderately eroded A and B slopes of the deep, well-drained soils (Wellston, Zanesville, Holston) are also class III land. Four-year rotations are usually satisfactory on these areas if supported by contour strip cropping or terracing and by sod waterways. For these deep soils the width of the cultivated strip may range from 100 feet on the lower limits of the B slopes to 85 feet on the upper limits.

On these soils, long slopes less than 12 percent may be terraced rather than strip-cropped. On strip-cropped fields a few terraces may be built on the upper part of long

slopes to protect the lower part. Strip cropping in conjunction with terracing provides one of the most effective erosion-control measures for these soils. Some of the moderately eroded slopes under 12 percent may be farmed in a 3-year rotation of corn, wheat, and hay if the fields are terraced and strip-cropped, and if the fertility is maintained. As on class II land, this means heavy applications of manure, fertilizer, lime, and the plowing under of green-manure crops and crop residues. On long slopes over 12 percent it may be necessary to build a diversion in about every fourth strip to break up the length of the slope and carry off the excess water.

The class III areas of the imperfectly drained deep upland and terrace soils (Tilsit, Monongahela, Captina) may be farmed in the same rotations and by following the same practices as those recommended for the well-drained deep soils. Some seep spots on these imperfectly drained soils must be tile drained if they are to produce satisfactory crop yields.

Shallow gullies have been formed on some class III land. If in waterways, maintenance in wide grassed strips will heal the gully and prevent further cutting. Careful strip cropping of the field, particular attention to diversion of water through terraces or diversions, or a somewhat longer period in hay will generally control other shallow gullies.

The use of barnyard manure has been generally recommended for all cropland. On many farms there is not enough manure available for all cropland in classes I, II, and III. If the supply is limited, it should be spread where the need is greatest, such as on lands in classes III and II. If there is any surplus, it can be used on class I land.

Seedings for meadows in classes I, II, and III should consist of mixtures of grasses and legumes. Soils properly limed and fertilized should be seeded to a mixture of 4 pounds of red clover, 4 pounds of alfalfa, 2 pounds of alsike clover, and 4 pounds of timothy per acre. The timothy may be sown in the fall with the winter wheat and the clovers and alfalfa in the spring. If the meadow is to stand 4 years, as in 6-year rotations, the alfalfa should be increased to 6 pounds and the red clover reduced to 2 pounds. Recommendations of the Ohio Agricultural Extension Service should be followed on lime, fertilizer, and manure.

Class III land that receives little or no lime and fertilizer should be seeded to a mixture of 6 pounds of red clover, 2 pounds of alfalfa, 2 pounds of alsike clover, and 4 pounds of timothy per acre. It is recommended that

<sup>3</sup> GERDEL, R. W. SOIL LOSSES FROM CULTIVATED STRIPS IN STRIP-CROPPED FIELDS IN THE OHIO VALLEY REGION. U. S. Dept. Agr. Cir. 388, 23 pp. illus. 1940.



14-793; OH-25170

Figure 4.—*A*, Strip boundaries in this field to be stripped in a 4-year rotation of corn, wheat, and 2 years of hay have been laid out by plowing a single furrow; *B*, field strip-cropped in corn and grass.

these areas be limed and fertilized as soon as possible so that mixtures containing more alfalfa may eventually be seeded.

Meadows in rotations will serve well as supplemental pasture, particularly after the first year. Since they are easily damaged by

close grazing, especially in the late summer and fall of the first year, grazing should be carefully controlled. They must be carefully managed to secure maximum yields and good quality hay as well as to furnish cover for the land.

#### CLASS IV LAND

Class IV land, shown on the map in blue, should be used primarily for long-term hay or permanent pasture. This land is either too steep, too subject to severe erosion or already too severely eroded, or too poorly drained to be used in rotations that include cultivated crops regularly. There are 35,252 acres of class IV land in Muskingum County, or 9 percent of its area, and 35,018 acres in Guernsey County, or 11 percent of its area.

More than a third of the class IV land consists of uneroded or slightly eroded A slopes of the poorly drained soils (Mullins silt loam on the uplands, Blago silty clay loam and Tyler silt loam on terraces, and Atkins, Holly, and Melvin silt loams on the first bottoms). Although in very dry seasons fair to good yields of corn, soybeans, and small grain may be obtained on some of these soils, in ordinary and wet seasons such crops would be drowned out. Installation of drainage would be very costly and subsequent yields would hardly justify the expense on most of these soils. Blago silty clay loam is an excellent corn soil if adequately drained and could be used in regular rotations once drainage is installed. For the most part, however, these poorly drained soils are best used for long-term hay and pasture.

A very small part of the class IV land is made up of severely eroded B slopes and slightly eroded C slopes of the imperfectly drained soils of the uplands and terraces. Mixtures of 2 to 4 pounds of redtop, 3 to 6 pounds of alsike clover, and 3 to 4 pounds of timothy should be sown on these soils, following applications of superphosphate at the rate of about 400 pounds per acre. In very wet areas, Reed canary grass will prove more successful. Limestone is not generally justified except on the better drained areas.

Hay stands on these soils may be renewed by small grain or a row crop followed by small grain if these lands are needed occasionally for corn. Corn will usually be successful only in favorable seasons in which the soils dry out early in the spring. Soybeans may be grown with a fair amount of success. "Bedding up" or plowing in narrow lands when renewing hay will improve drainage.

The remainder of the class IV land consists of severely eroded B slopes and slightly

eroded C slopes of the well-drained upland and terrace soils. If these soils are to be protected from further erosion, they must be kept under a cover of vegetation such as afforded by permanent pasture or long-term hay.

Mixtures recommended for long-term hay on these better drained soils consist of alfalfa and timothy or alfalfa and orchard grass. Alfalfa stands can be more easily established on the limestone soils of group 4 than on the soils in the other groups. With liberal applications of lime and phosphate fertilizer, however, alfalfa may generally be successfully grown on the sandstone and shale soils. Severely eroded land may need to be limed and fertilized and seeded to sweetclover or other clovers and grasses with a very limited amount of alfalfa and left for 5 or 6 years before reseeding to a mixture containing larger amounts of alfalfa.

A seeding of 10 pounds of alfalfa, 2 pounds of alsike clover, and 4 pounds of timothy on soils adequately limed and fertilized will usually remain productive for 3 to 5 years if not overgrazed or subjected to untimely cutting. Three cuttings may be obtained annually under normal conditions.

Soils receiving little or no lime and fertilizer can be seeded to a mixture of 4 pounds of timothy and 2 pounds of redtop in the fall, to be followed by a seeding of 4 pounds of orchard grass, 3 pounds of alsike clover, and 3 pounds of Korean lespedeza the next spring. These soils should be limed and fertilized, however, as soon as possible in order to include alfalfa in the seedings.

As these meadows become unproductive they should be renewed by plowing, additional treatments with lime and fertilizer if necessary, and reseeding with small grain. The entire field should not be broken at any one time but should be plowed in narrow strips on the contour. Two or more years should be allowed for renewal. As a rule, at least two-thirds of the field should be kept in grass at all times. On slopes over 300 feet in length that are to be cropped or that are now gullied, diversions may be necessary to break up the length of the slope and carry off excess water (fig. 5).

These long-term hay lands may be grazed if the number of livestock and time of grazing are carefully controlled. If they are to be used for pasture in the summer, they should be cut early and then not grazed until there is at least 6 inches of fresh growth. If they are to be cut again for hay in the late summer, livestock should be removed early in August.



OH-50120

Figure 5.—A diversion just constructed on a long slope on class IV land. Water is to be discharged at right angles to slope into a natural rock drainageway.

#### CLASS VI AND VII LAND

Land in classes VI and VII is not suitable for cultivation because of steep slopes, present degree of erosion, or extreme susceptibility to erosion. These lands should be maintained under a permanent cover of grass or trees. Class VI land requires moderate restrictions of grazing and woodland cutting to safeguard the land, whereas class VII land requires severe restrictions. Practically speaking, in this section of Ohio class VI land is steep erodible land suited to permanent pasture and class VII land, which is even steeper and more severely eroded, is more safely and profitably utilized as woodland.

Class VI land, shown on the map in orange, occurs entirely on the uplands and terraces of the two counties. On the shallow well-drained upland soils it consists of very severely eroded B slopes and moderately eroded C slopes. Where it occurs on the steep upland soils it consists of very severely eroded B slopes and moderately and severely eroded C slopes. Very severely eroded B slopes and slightly eroded C slopes of the terrace soils are included in class VI, and also A slopes and not more than moderately eroded B slopes of the stony soils.

There are 55,623 acres of class VI land in Muskingum County, amounting to 14 percent of its area, and 33,194 acres in Guernsey County, or 10 percent of its area. Of this land, 29,123 acres in Muskingum County and

16,467 acres in Guernsey County are now in permanent pasture. But there are also 11,187 acres in Muskingum County and 5,786 acres in Guernsey County still being used regularly for crops. These areas should be converted to permanent pasture or woodland as rapidly as possible to prevent further soil loss. The class VI land now idle or abandoned should be either converted to pasture or planted to trees, as the farmer's needs indicate. The class VI land now in trees should not be cleared but allowed to remain under a good woods-management program.

Recommendations for pasture treatment and management are outlined under Permanent Pastures.

Class VII land, shown on the map in brown, is best maintained under woodland cover if further soil loss is to be prevented. It is also the land on which restrictions in cutting timber are the most severe. Class VII land is extensive in the two counties—103,151 acres or 25 percent of Muskingum County, and 120,539 acres or 37 percent of Guernsey County. Land so classified consists almost entirely of steep and severely eroded shallow and stony soils.

A large part of the class VII land is already in woodland but there are also large acreages now idle, in cropland, or in pasture. Those being used for crops should be taken out of cultivation immediately and planted to trees. The idle lands should be planted as rapidly as practicable not only to establish them in a use that will bring some return but also to protect better lands adjacent to or below these areas.

Permanent pastures on class VII land are for the most part too steep or too cut up by gullies to be crossed with the machinery necessary for pasture improvement. In many places the soil is so thin that desirable plants are burned out in midsummer and a good sod cannot be maintained. These areas should be reforested.

Reforestation of much of this class VII land will be difficult and time consuming. Woodland and planting recommendations are outlined under Farm Woodlands.

#### CLASS VIII LAND

Class VIII land, shown on the map in purple, is not suitable for any cultivation or for the production of any vegetation that may be harvested by grazing or by the cutting of timber. In Muskingum and Guernsey Counties it consists entirely of mine pits and dumps, strip-mining areas, and stone quarries. As no slope or erosion symbols



were mapped on these areas in the survey, their acreage is not included in any of the tables showing the results of the survey. There are 1,877 acres of this type of land in Muskingum County and 231 acres in Guernsey County.

For the most part, these areas should be abandoned to nature and let grow up in any shrubs and trees that can establish themselves. No attempt should be made for many years to harvest any timber. On a few of the abandoned strip-mining areas where liny material has been thrown up near the surface, it may be possible to obtain a seeding of sweetclover for forage or to plant black locust with the possibility of eventually obtaining a few fence posts. Some of this land may be developed as wildlife or recreational areas.

#### PERMANENT PASTURES<sup>4</sup>

At the time the soil conservation survey was made about 40 percent of each county was in permanent pasture. Many of these pastures are on steep eroded upland slopes that were used for crops until they became unproductive and since then have been used for pasture and have received little or no treatment. The vegetation now consists of poverty grass, broomsedge, cinquefoil, and briars. The remainder of the permanent pastures are on level first bottoms, terraces, and the less steep uplands. Although these are commonly the most productive pastures, in many the percentage of desirable grasses and clovers is low because of overgrazing and lack of treatment.

One of the first steps in maintaining productive pastures is the correction of acidity by liming and the replenishment of nutrients by fertilizing according to the needs indicated by soil tests and plant growth. Applications of 2 to 3 tons of lime per acre are usually necessary to secure good stands of the desired legumes and grasses. Twenty-percent superphosphate or its equivalent should be applied at rates ranging from 300 to 500 pounds per acre. Adequate applications of lime every 8 to 10 years and fertilizer every 4 or 5 years will usually maintain the average pastures without reseeding on land in capability classes I, II, and III. The proportion of desirable grasses and legumes will increase rapidly under such treatment.

A good even growth should be maintained by controlled grazing and periodic mowing.

<sup>4</sup> For more complete information on the maintenance and establishment of pastures, the reader is referred to the following bulletin from which much of the material on pastures has been adapted: DODD, D. R., and SALTER, R. M. BETTER PASTURES FOR OHIO LIVESTOCK. Ohio Agr. Col. Ext. Bul. 154, 32 pp. [1934.]

Particular care is necessary in the early spring, during the hot dry summer months, and in the late fall and winter. A rotation system of grazing will enable farmers to move livestock from pastures where the grass has been grazed down to other pastures in which grazing has been deferred or to rotation meadows and supplemental pastures. Mowing pastures as soon as livestock are removed is of great help in keeping the growth even and of good quality. Where growth is kept even by carefully controlling grazing, mowing in the middle of June and sometimes again in early September, or just before or about the time the weeds are starting to bloom, will eliminate most of the weeds. On productive pastures droppings should be scattered evenly over the fields at the close of grazing periods. These are scattered somewhat by mowing but better by using a flexible or chain harrow. This prevents the development of heavy, ungrazed clumps of grass around dung piles. Burning of pastures is not recommended.

If rapid improvement is desired, or if the percentage of desirable grasses and legumes is very low, reseeding may be necessary. Ordinarily, after the proper applications of lime and fertilizer have been made, the pasture mixture may be sown without further preparation of the land, but if the pasture is extremely weedy or if poverty grass has formed a dense mat, it may be desirable to plow or disk and reseed. Pastures on land in capability classes I and II may be plowed and limed in accordance with the soil needs. A good seedbed should be prepared and the pasture mixture seeded with a small-grain companion crop. Applications of 300 to 500 pounds of 20-percent superphosphate, 0-12-12 or 4-12-12, should be made with the seeding. The companion crop may be removed either by grazing or for hay or grain. Grazing should be light the first year after reseeding. Mixtures to be used to thicken up old pastures should consist of 5 to 6 pounds of Kentucky bluegrass, 1 to 2 pounds of redtop, and 3 to 4 pounds of timothy in the fall, followed by a mixture of  $\frac{1}{2}$  to 1 pound each of white and Ladino clovers, and 2 pounds of alsike clover or 4 pounds of red clover in the spring. A full seeding is seldom necessary if the land is properly limed and fertilized.

Pastures on class III land, which is steeper and more eroded, should be reseeded in strips on the contour, several years being allowed for the reestablishment of the entire slope, or it may be possible to plow the entire field and reseed it with a companion crop of grain.

Small shallow gullies or rills in pastures in classes II and III will usually be headed over by the increased growth of desirable grasses and legumes resulting from good pasture treatment and management. If gullies are actively cutting, however, it is necessary to use some special means to control further cutting and to encourage vegetation. Water should be diverted by a small diversion ditch or by a series of two or three furrows plowed in a herringbone pattern above the head of the gully. The water so diverted should be discharged onto well-sodded areas or spread out so that new gullies are not cut. Once water is diverted, the sides of the gully should be plowed or disked to a more stable gradient, limed, fertilized, and seeded to a mixture of Kentucky bluegrass, Canada bluegrass, redtop, timothy or orchard grass, and white, Ladino, and alsike clovers. A loose pile of thorny brush, such as osage orange and thornapple, laid over the newly seeded gully will keep livestock away until a good sod has been established. The brush will not only prevent grazing and trampling by stock but will also serve as a mulch to conserve moisture, supply thin shade, and help to hold the loose soil in place until vegetation is established.

Occasional deep gullies should not only be treated and seeded but also planted to black locust and protected from grazing until the trees are above the livestock. Water should be diverted from these areas by a diversion ditch or furrows in a herringbone-pattern.

Pastures on class IV land require the good management recommended for those in classes I, II, and III. Pasture mixtures for the poorly drained soils should consist of grasses and legumes suited to wet lands, such as timothy, redtop, and on better drained areas alsike clover. If the lands are submerged a great part of the year as some of the bottom lands in soil group 7c are, Reed canary grass should be sown.

Reseeding of pastures on well-drained class IV land requires especial care. At least two-thirds of the slope should be maintained in grass at all times and the land should be plowed in narrow strips on the contour, so that several years are allowed for renewal. Figure 6 shows gully erosion on steep pastures.

Careful treatment and management are required on the steeper and more eroded pastures on class VI land. They should not be plowed but should be renewed by disking, liming, fertilizing, and reseeding as necessary. Good results have been obtained by seeding a mixture of about 12 pounds of

sweetclover and 2 to 4 pounds of Kentucky bluegrass.

As previously mentioned there are areas in both classes IV and VI now in crops or idle that should be converted to permanent pasture. It is often difficult to establish good stands of grasses and legumes on these depleted lands and it is essential to make the soil as productive as possible if the pastures are to be profitable. Lands now being farmed in rotation may be seeded to small grain, with heavy applications of fertilizer and lime as needed. Grasses should be sown in the fall with the grain crop and the legumes early in the spring. On some small areas it may be desirable to grow a green-manure crop such as sweetclover or soybeans, and disk it in before seeding the grasses and nurse crop in the fall. Grazing should be light until the new seeding is established.

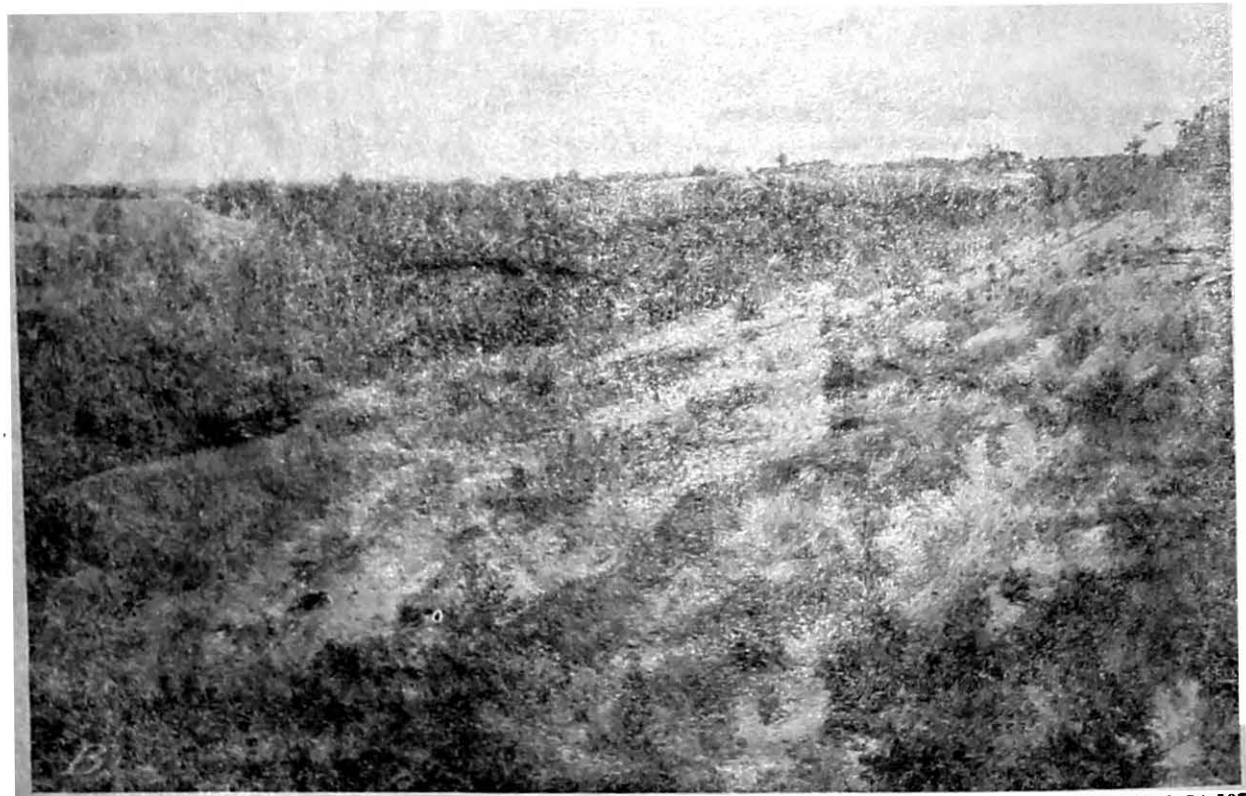
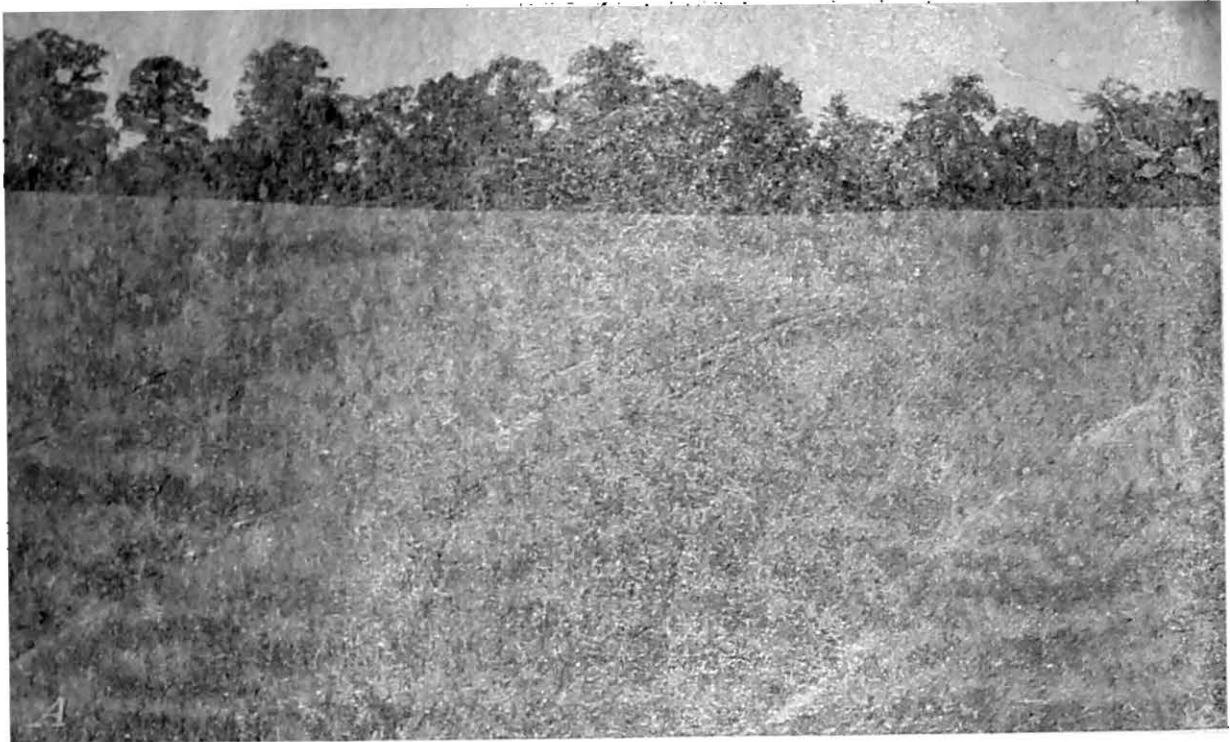
Many of the pastures on land in classes IV and VI, particularly in southern Guernsey County, are marked by landslides or slips which give a bumpy appearance to the landscape (p. 44). They are very susceptible to the formation of gullies that, if uncontrolled, will soon cut into other lands. A good seedbed should be prepared on the slip and the area reseeded. Diversion of water from the unstable area by a diversion above it will help prevent further trouble. Locust and walnut trees will also be helpful in holding the soil.

If it is necessary to retain any class VII land in pasture temporarily, special treatment and management are required. Grazing should be very carefully controlled and permitted only where there is good growth and when livestock will do no damage to the soil.

#### FARM WOODLANDS

At the time the soil conservation survey was made a little more than one-fifth of each county was in woodland. About 90 percent of the woodland is on the upland soils.

Most of these farm woodlands have been grazed along with adjacent pastures, and the undergrowth and leaf litter have been trampled and destroyed. Such destruction gives rise to sheet erosion and eventually exposes tree roots. Both dead and dying trees are common. Most of the farmers have clear cut their timber; few have cut only mature trees. Clear cutting is often followed by fire that completely destroys any remaining protective covering on the ground. Few farmers carry on any woods improvement, and it is not the practice to remove weed trees and diseased or dead trees. As a result undesirable species are



OH-50116, 14-105

**Figure 6.—A, This entire slope was plowed at one time to reseed to pasture. One storm of 0.55 inch of rain in 5 minutes caused these rills. If not controlled, they will develop into gullies such as those shown in B. B, Gully erosion in an overgrazed pasture.**

dominant in many of the woodlands and the growth of desirable trees is slow. Both the quality and quantity of the timber produced for market are poor. With proper woodland management the present annual yield of lumber can be materially increased.

Although most of the existing woodland is on the eroded steep slopes in capability class VII, there are small but important wooded areas in the other capability classes. Those in capability classes I, II, and III are generally operated as small wood lots on farms, which are important primarily from the standpoint of furnishing fuel, fence posts, poles, and the small amounts of lumber necessary on every farm. Larger wood lots, if properly managed, will produce market products.

Existing woodlands on all classes of land should be fenced against grazing to prevent eating of the undergrowth and trampling of forest litter by livestock. All wood lots should be protected from fire.

The first priority in any woods-improvement work should be given to the removal of grapevines as soon as possible and the removal of wolf, weed, and other poor trees as rapidly as is consistent with the farmer's needs for fuel, poles, posts, and other home products. A few den trees should be left, particularly along borders, as wildlife shelters. Protection from fire and grazing and the thinning of stands in this manner will permit natural reproduction of the better trees and encourage the development of stands of all ages and sizes, which will provide

protection against erosion and a continuous supply of forest products. Figure 7 shows a farm wood lot after improvement work had been completed. Mature trees should be cut periodically as home needs and good markets warrant, on a selection basis. There should be no clear cutting.

Tree planting on land in capability classes I, II, III, and IV will generally be confined to interplanting in existing wood lots in which there are only a few seed trees or where there are fairly large openings, field plantings of newly cut-over areas or areas inconveniently located to the general farming operations, and gully plantings. Plantings on land in classes VI and VII will usually consist of gully plantings and field plantings on steep slopes on which both sheet and gully erosion are commonly severe. Trees to be used in any planting should be determined by the location and condition of the site.

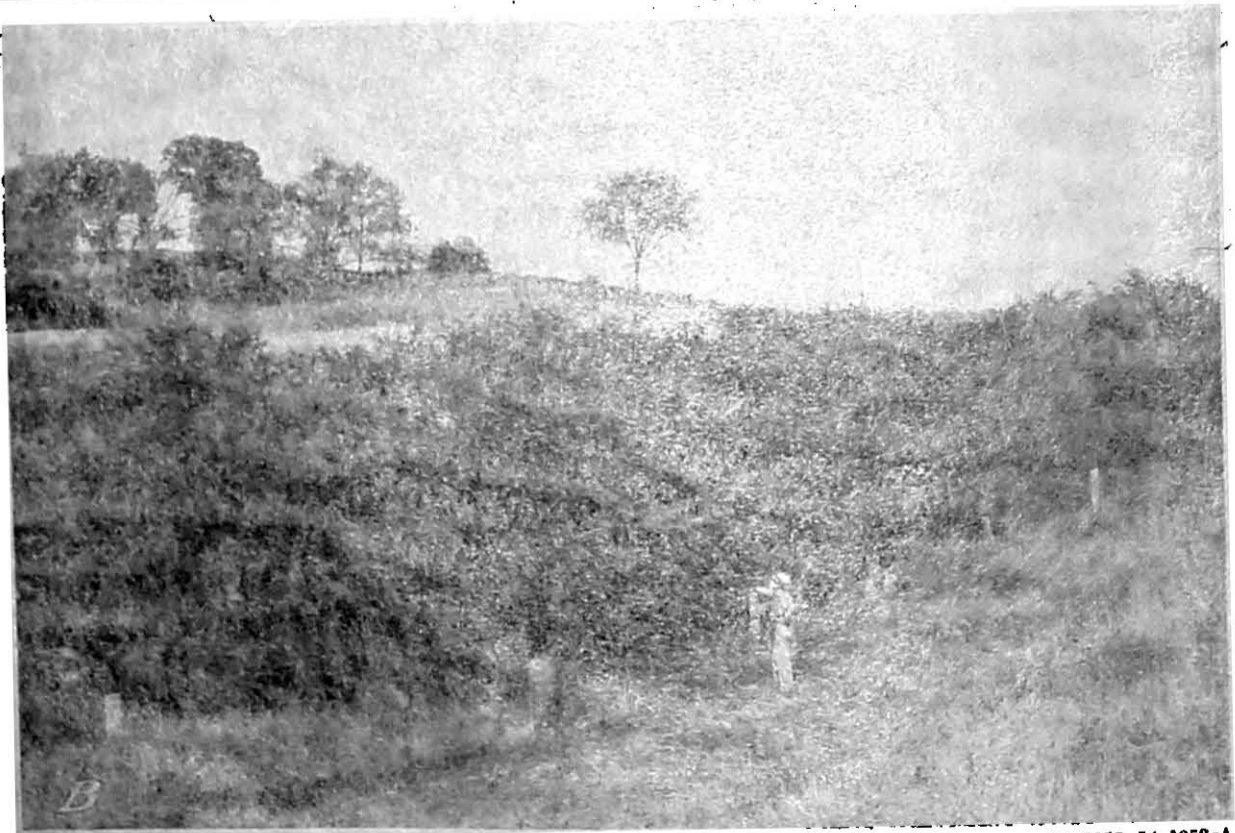
Yellow poplar, black walnut, and the better quality of oaks are well suited to the more productive bottom lands. About the only new planting required on these sites, however, is on newly cut-over lands of some size.

With only a few exceptions, field plantings should consist of conifers and in some places



OII-14-491-A

Figure 7.—A wood lot in which improvement work has just been completed. Thinning operations yielded 9 cords of wood, 28 poles, 4 braces, and 34 board feet of lumber.

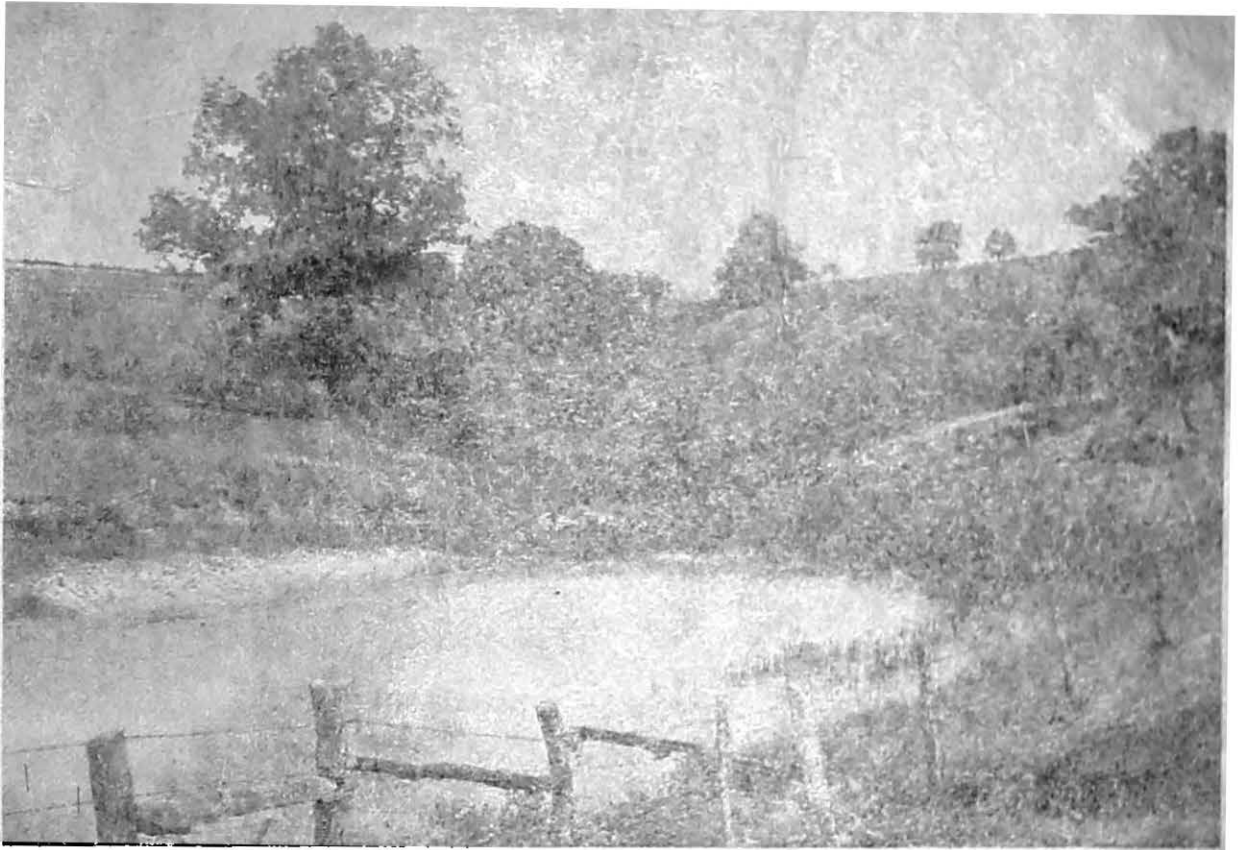


14-1058; 14-1058-A

**Figure 8.**—Cullied area planted to black locust: *A*, Just before planting; *B*, after four growing seasons.

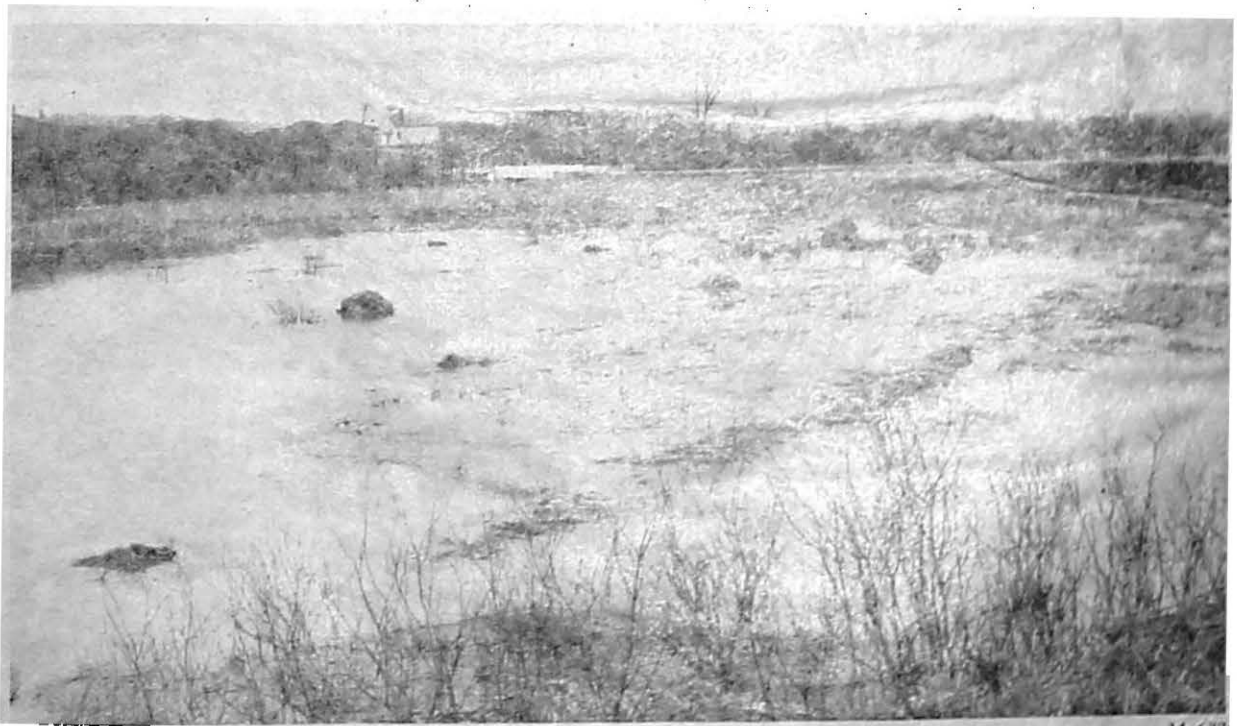
black locust. The common hardwoods will generally succeed only where the soils are uncruded and where forest conditions of un-

compacted soils and good leaf litter are present. White and red pines may be used in field plantings where the soils are only



OH-1613

**Figure 9.**—A farm pond. Cattails around the edge and lanes of cattails, elderberry, and blackberry furnish food and cover for wildlife.



14-632

**Figure 10.**—Dug-over land resulting from strip-mining operations supplies shelter for wildlife. Note muskrat houses scattered over area.

slightly or moderately eroded. White pine should be favored on areas only slightly eroded and with plenty of available moisture. White pine should not be planted near gooseberries and currants, however, because of danger of blister-rust infestation. Shortleaf, Virginia, pitch, and Scotch pines should be used on the severely and very severely eroded areas. On the Salt Creek demonstration project field plantings of black locust have been successful on the more productive soils containing some limestone, such as the Belmont and Westmoreland soils, but have failed on the less productive sandstone and shale soils. Gully plantings should consist of black locust (fig. 8) or, on deep gullies, red, Scotch, and pitch pines. The diversion of water by a small diversion ditch or furrows in a herringbone pattern may be necessary in starting gully plantings.

Planting sites should be prepared by "scalping" or by contour furrowing. Small areas are most easily planted by scalping, that is, by removing sod and vegetal litter from a spot about 18 inches square, thus exposing the soil in which the planting hole is to be dug. In larger areas, plowing contour furrows and planting trees in the ridge will reduce hand labor. Steep and severely eroded slopes on which plowing would promote further soil loss should be planted by scalping. All new field and gully plantings should be protected from grazing and fire.

#### WILDLIFE PRACTICES

Production of wildlife in this area has declined with continued soil depletion. Abundance of wildlife is dependent upon the productiveness of the land, and an improvement in wildlife conditions can be expected as soil-conserving practices become established. The use of such practices as longer rotations, protection of woodlands, establishment of tree plantings, and protection of idle areas from fire and grazing provides more and better distribution of wildlife food and cover.

Many areas in and near crop fields can be utilized as wildlife refuges, thereby furnishing greater protection to the land without disturbing farm operations. Grassy vegetation in natural waterways protects them from gullying and furnishes food and cover for field birds and rabbits. A hay-type vegetation in field borders prevents erosion, affords a turning place for farm machinery, prevents the encroachment of trees, and favors wildlife.

The natural woody vegetation that grows along many fence rows and in fence corners is an excellent habitat for game and song-

birds. It may be necessary to plant some fence rows and corners to shrubs and low-growing trees if no vegetation is present. Shrub borders around farm stock ponds are very productive wildlife habitats (fig. 9).

The selection of shrubs to be planted in any of these areas should be determined by soil and erosion conditions. Shrubby St. Johnswort, coralberry, shrub lespedeza, native pasture rose, and introduced multiflora rose grow well on severely eroded sites. Wild plum, hazelnut, blackhaw, and gray dogwood will grow on sites where the erosion conditions are not so severe.

Gully plantings and thicket plantings in galled spots in crop and pasture fields or on rocky outcrops are excellent sources of food and cover for wildlife. All these simple uses of otherwise nonagricultural land have the double advantage of protecting the soil and supplying cover and food for wildlife. In addition, their location near cultivated areas enables wildlife who take cover in them to obtain additional food from crop wastes.

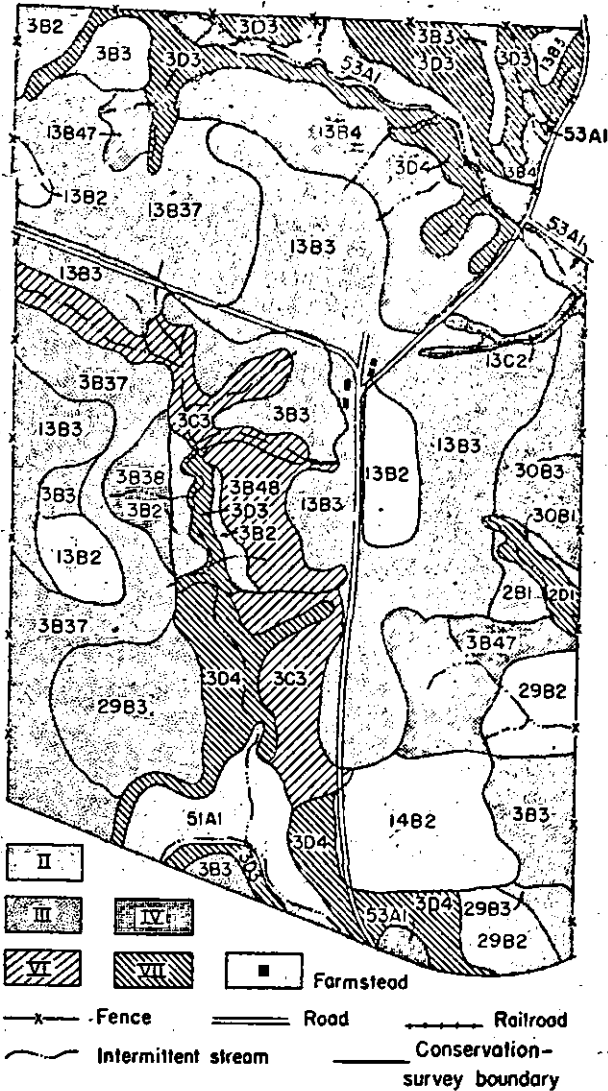
Hollow den trees and dense undergrowth in protected woodlands, particularly along the outer margin, serve as shelters for raccoons and squirrels and as nesting places for birds. Loose piles of brush resulting from cutting operations furnish shelters for rabbits and other animals. The value of woodlands for wildlife is greatly increased by a border of low-growing pines and shrubs. The usual procedure is to plant a row of pines next to the woods and one or two outer-rows of low-growing shrubs.

Many small areas of poorly drained bottom land in capability class IV and strip-mining areas in class VIII may be developed for fur production as a source of supplementary income for farmers. Figure 10 shows a number of muskrat houses built on such land.

#### *An Example of Conservation Farming*

Figures 11, 12, and 13 show how the survey was used in planning for the conservation farming of a 248-acre farm in the Salt Creek demonstration project. This farm, although larger than the average, is representative of many farms in Muskingum and Guernsey Counties that are located on the sandstone and shale soils and that have a range of relief from nearly level bottom lands to steeply sloping uplands. The farmer derives most of his income from livestock and livestock products, and the grain grown is fed largely on the farm. He carries 30 head of livestock, of which 12 are dairy cows and the rest young heifers or beef cattle.

There is no class I land on the farm.



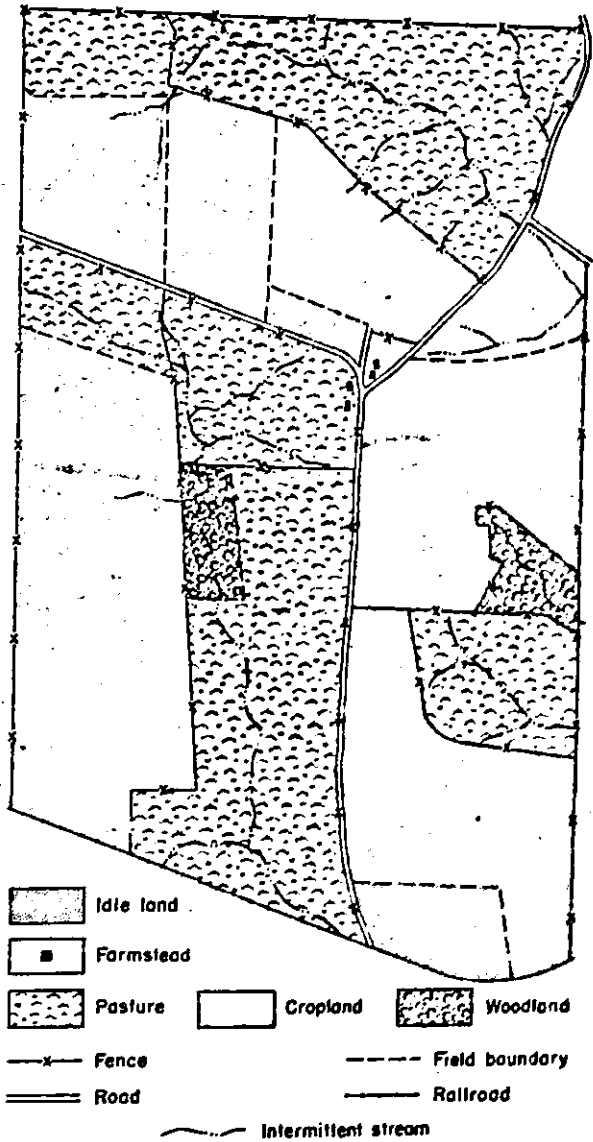
N-3896-2

Figure 11.—Physical survey of a farm of 248 acres, showing the land-capability classification. The composite symbols show soil type, slope, and erosion. Soil legend: Group 1, 2, Muskingum loam; 3, Muskingum silt loam; group 3b, 13, Wellston silt loam; 14, Zanesville silt loam; group 5a, 29, Holston silt loam; 30, Holston silt loam, high terrace phase; group 7b, 51, Philo silt loam; group 7c, 53, Atkins silt loam. Slope legend: A, less than 5 percent; B, 5 to 20 percent; C, 20 to 30 percent; D, 30 or more. Erosion legend: 1, no apparent erosion; 2, slight erosion; 3, 37, moderate erosion; 38, 4, 47, severe erosion; 48, very severe erosion.

The 30 acres of class II land consist of an area of Philo silt loam, an imperfectly drained bottom-land soil, and some slightly eroded B slopes of Wellston silt loam on the uplands and of Holston silt loam on the terraces. The class III land (128 acres) consists of slightly and moderately eroded B slopes of Muskingum silt loam and moderately eroded B slopes of Wellston silt loam and Holston silt loam, high-terrace phase. A strip of Atkins silt loam, a poorly drained bottom-

land soil, and some severely eroded B slopes of Muskingum silt loam make up the 34 acres of class IV land. Class VI land, consisting of moderately eroded C slopes of Muskingum silt loam, makes up 20 acres, and class VII land, D slopes of Muskingum silt loam, 36 acres.

Of the 134 acres in cropland at the time of the survey, about half were in hay. No definite rotation was followed. It was the farmer's practice to seed a grass-legume mixture in the wheat and allow the succeeding hay to stand for 3 or 4 years, and then use it for pasture for several years before re-plowing this land for corn. There were 99 acres of pasture and 8 acres of woodland, part of which was grazed by livestock in conjunction with adjacent pasture. The



N-3896-4

Figure 12.—Land use map of the farm shown in figure 11 at the time the survey was made.



house and nearby farm buildings occupy about an acre. Six acres were idle.

Figure 12 shows the farm as replanned by the farmer and soil conservation technicians. Fields 3, 4a, 8a, 9, and 13a, composed of land in classes II and III, were chosen for the land on which to grow the necessary grain crops. Field 3 as formerly laid out had contained some class IV and VII land. A new fence was built, removing this land from field 3 and combining it with field 1 to be seeded and used for permanent pasture. Several segments of severely eroded and steeply sloping land were fenced out from the original field 9 and the rest of the field used for cropland. All these cultivated fields are strip cropped and cultivated on the contour. The strips are approximately 85 feet wide, although their exact width was determined by adherence to the contour and by the number of corn rows going into a shock. All waterways in cultivated fields are now maintained in grass. The fields are farmed in a definite 4-year rotation of corn, wheat, and 2 years of hay.

Formerly none of these cultivated fields had been limed. The farmer has now applied 2 to 2½ tons of ground limestone per acre and further applications of 1 to 1½ tons will be made each rotation. He is continuing his former program of applying 150 pounds of 2-14-4 per acre on the cornlands and 150 pounds of 20-percent superphosphate per acre on the wheatlands.

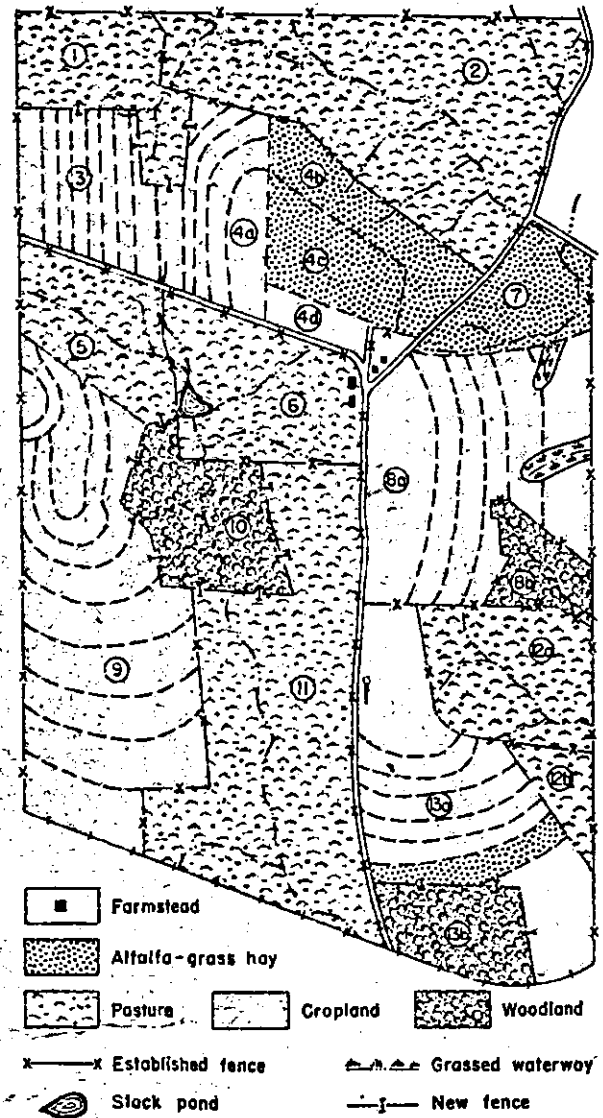
Fields 4b, 4c, and 7 have been seeded to an alfalfa-grass mixture and will be maintained as long-term hay, being plowed only when necessary to reseed. These fields all contain some class IV land that had formerly been used for regular cultivation. They were treated with 3 tons of ground limestone and 400 pounds of 0-14-6 per acre. The strip in field 13a seeded to an alfalfa-grass mixture was treated in the same way.

Field 4d, adjacent to the farm buildings, is now used for a vegetable garden and truck crops.

Fields 1, 2, 5, 6, 11, 12a, and 12b are in permanent pasture. Field 1, enlarged by land fenced out from field 3, is pastured with field 2, since a water supply was available only in field 2. Field 5 was enlarged by seeding the eroded land fenced from field 9. The existing boundaries of fields 6 and 12a were retained. A stock pond was built in field 6 as a source of year-round water supply. Field 12b was taken out of cultivation, fenced, and seeded with a pasture mixture. All the pastures are to be treated with 2 tons of ground limestone and 300 pounds of 20-percent superphosphate per acre. Some of

them have been so treated, and the rest will be treated as soon as the farmer is able to buy the necessary lime and fertilizer. The pastures are grazed in a rotation system, and the number of livestock and time of grazing are carefully controlled. Fields 1, 2, and 11 contain some class VII land, and grazing must be carefully limited and care taken to maintain a good sod if erosion is to be controlled. Eventually, these steeper slopes should be reforested as the carrying capacity of the other pastures increases.

The gullied area cut from field 9 was planted to black locust and pines. A fence



N-3896-3

Figure 13.—Land use on the farm shown in figures 11 and 12 as revised in the conservation plan. Conservation measures include strip cropping and contour cultivation of cultivated fields; grassed waterways; long-term hay on steeper and eroded croplands; improvement of pastures; relocation of field boundaries; planting of trees in gullied areas; and exclusion of livestock from woodland.

was built around this newly planted area and the rest of field 10, thus excluding livestock from all this woodland. Field 13b, which had been idle and was severely eroded, was planted to pine trees and fenced. Field 8b remains in woodland protected from grazing.

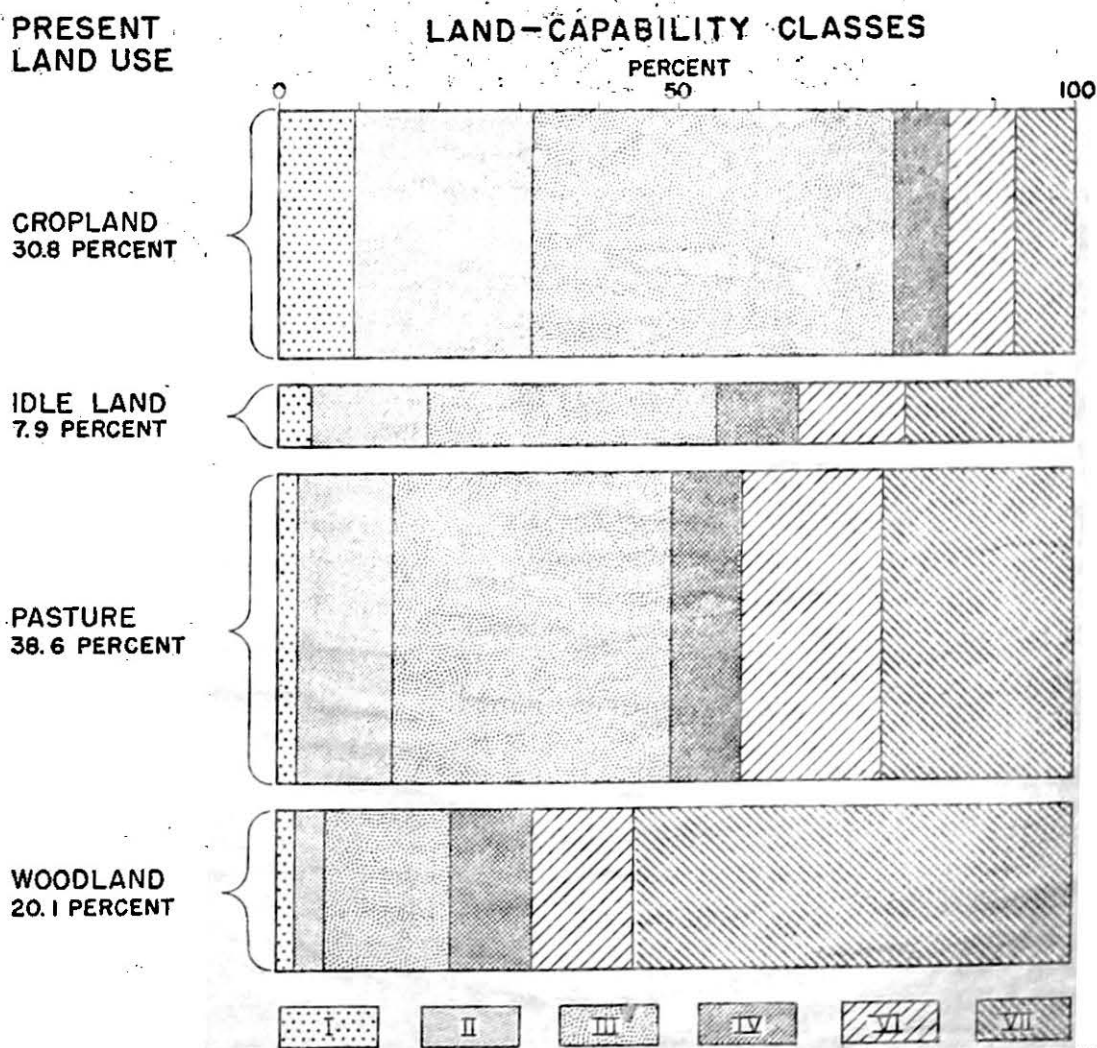
The farmer now has 94 acres of protected rotation cropland, 2 acres of truck crops, and 22 acres of alfalfa-grass hay. He has 110 acres of permanent pasture which is gradually being treated to increase its carrying capacity and on which grazing is controlled. He has 19 acres of protected woodland, which will furnish him with fuel, fence posts, and poles, and eventually some timber for market.

The conservation practices adopted on other cooperating farms in the Salt Creek demonstration project are similar to those shown on this farm. On some of the farms, in addition to these practices, terraces and

field diversions were built to divert water flowing down long slopes. Not all the necessary measures were installed in 1 year but were spread out over several years so that the outlay for labor and materials was not excessive at any time.

### Results and Significance of the Physical Land Inventory

A SUMMARY OF the data from the soil conservation survey makes it possible to evaluate the general land resources of Muskingum (table 3) and Guernsey Counties (table 4). It also brings out the adjustments that must be made if land use is to be brought into harmony with the physical capability of the land. Graphic presentations of land capability by present land use classes are given in figures 14 and 15.



N-3896-5

Figure 14.—Present land use and land capability in Muskingum County. Classes I, II, and III are suitable for cultivation; class I without special practices, class II with simple practices, and class III with intensive practices. Classes VI and VII are not suitable for cultivation; class VI land is recommended chiefly for permanent pasture and class VII land for woodland.

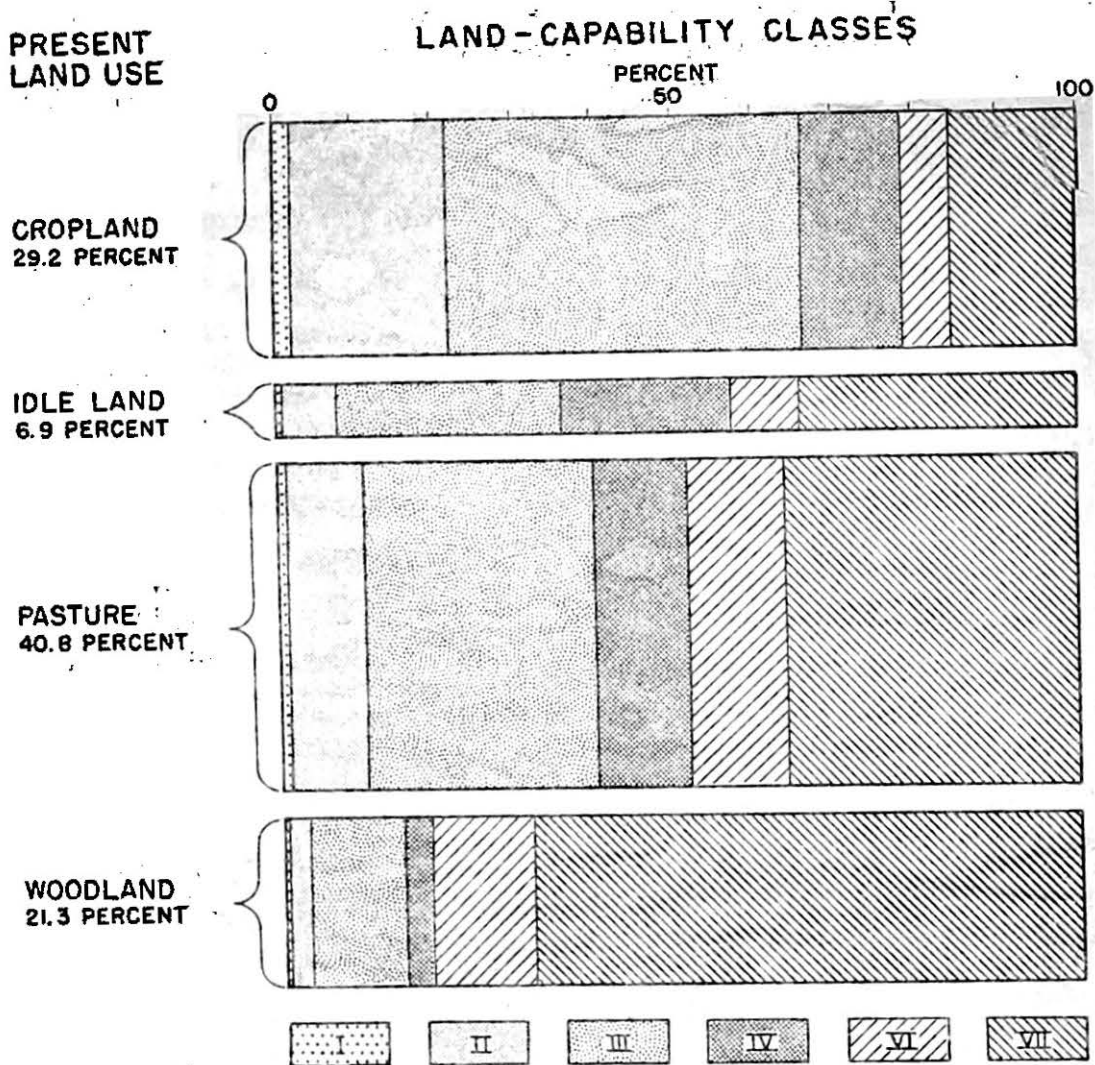


Figure 15.—Present land use and land capability in Guernsey County. See the caption of figure 14 for the explanation of the land-capability classes.

TABLE 3.—Capability of land for use, by soil groups, in Muskingum County<sup>1</sup>  
ENTIRE COUNTY<sup>1</sup>

Soil group	Area and proportion in land-capability class—												Total Acres
	I (green) <sup>2</sup>		II (yellow) <sup>3</sup>		III (red) <sup>4</sup>		IV (blue) <sup>5</sup>		VI (orange) <sup>6</sup>		VII (brown) <sup>7</sup>		
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	
1. Shallow soils developed on sandstone and shale or cherty limestone.....	306	0.1	495	0.2	82,772	37.4	17,064	7.7	39,995	18.0	80,990	36.6	221,622
2. Soils with heavy clay subsoils developed on shale and sandstone.....	17	.2	85	.4	4,080	51.0	454	4.6	1,917	19.6	2,359	24.2	9,762
3. Deep soils developed on sandstone and shale:													
a. Well-drained, on shale and sandstone.....	0		16	23.1	41	71.9	0		0		0		57
b. Well-drained, on sandstone and shale.....	33	.1	20,983	53.2	16,662	42.2	1,506	3.8	120	.3	171	.4	39,475
c. Imperfectly drained.....	0		1,652	55.8	888	29.9	324	10.9	64	2.2	42	1.4	2,970
Total, group 3.....	33	.1	22,651	53.3	17,551	41.4	1,830	4.3	184	.4	213	.5	42,502
4. Shallow soils developed on interbedded limestone, sandstone, and shale.....	164	.4	118	.3	24,421	53.3	1,760	3.8	11,732	25.6	7,615	16.6	45,819
5. Soils on terraces:													
a. Well-drained.....	1,188	4.7	18,793	54.7	8,596	34.1	149	.6	83	.3	1,414	5.6	25,213
b. Imperfectly drained.....	0		7,628	75.8	1,939	19.5	74	.8	15	.2	272	2.7	9,928
Total, group 5.....	1,188	3.4	21,421	61.0	10,525	29.9	223	.6	98	.3	1,686	4.8	35,141

TABLE 3.—Capability of land for use, by soil groups, in Muskingum County—Continued

ENTIRE COUNTY—Continued

Soil group	Area and proportion in land-capability class—												Total Acres
	I (green) 1		II (yellow) 2		III (red) 3		IV (blue) 4		VI (orange) 5		VII (brown) 6		
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	
6. Poorly drained soils on uplands and terraces	0		0		0		8,899	100.0	0		0		8,899
7. Alluvial soils:													
a. Well-drained	17,783	96.2	707	3.8	0		0		0		0		18,490
b. Imperfectly drained	0		10,622	100.0	0		0		0		0		10,622
c. Poorly drained	0		0		0		8,013	100.0	0		0		8,013
Total, group 7	17,783	47.9	11,329	30.6	0		8,013	21.6	0		0		37,125
8. Miscellaneous soils not suitable for cultivation	0		0		0		0		1,097	14.1	10,288	85.9	11,385
Entire county 1	10,491	4.8	50,049	13.7	140,280	34.2	35,252	8.6	55,623	13.0	103,181	23.1	609,865

CROPLAND

1. Shallow soils developed on sandstone and shale or cherty limestone	247	0.6	284	0.6	32,000	61.2	3,690	0.8	8,405	16.1	7,821	14.9	52,377
2. Soils with heavy clay subsoils developed on shale and sandstone	14	.6	25	1.0	1,811	75.3	43	1.8	312	13.0	190	8.3	2,404
3. Deep soils developed on sandstone and shale:													
a. Well-drained, on shale and sandstone	0		8	38.1	13	61.9	0		0		0		21
b. Well-drained, on sandstone and shale	5	(?)	9,571	51.0	9,027	48.2	83	.4	48	.3	10	.1	18,741
c. Imperfectly drained	0		607	58.6	456	40.0	12	1.1	5	.4	0		1,140
Total, group 3	5	(?)	10,246	51.4	9,490	47.7	95	.5	53	.3	10	.1	19,905
4. Shallow soils developed on interbedded limestone, sandstone, and shale	122	.9	56	.4	9,088	75.1	398	2.9	1,970	15.3	702	5.4	12,904
5. Soils on terraces:													
a. Well-drained	739	5.1	8,828	60.1	4,531	31.6	71	.5	14	.1	377	2.6	14,309
b. Imperfectly drained	0		4,720	79.6	1,076	18.2	18	.3	3	(?)	100	1.7	5,917
Total, group 5	739	3.6	13,548	65.8	5,607	27.7	89	.4	17	.1	477	2.4	20,226
6. Poorly drained soils on uplands and terraces	0		0		0		2,830	100.0	0		0		2,830
7. Alluvial soils:													
a. Well-drained	1,038	97.1	335	2.9	0		0		0		0		11,373
b. Imperfectly drained	0		4,499	100.0	0		0		0		0		4,499
c. Poorly drained	0		0		0		1,858	100.0	0		0		1,858
Total, group 7	1,038	62.2	4,834	27.3	0		1,858	10.6	0		0		17,730
8. Miscellaneous soils not suitable for cultivation	0		0		0		0		430	35.2	701	64.8	1,221
All cropland	12,165	9.4	28,793	22.2	58,660	45.3	8,863	6.8	11,187	8.6	10,000	7.7	129,698

IDLE LAND

1. Shallow soils developed on sandstone and shale or cherty limestone	0		26	0.1	8,176	41.1	1,737	8.7	3,827	19.2	6,145	30.9	19,911
2. Soils with heavy clay subsoils developed on shale and sandstone	0		2	.2	493	50.2	72	7.3	221	22.6	194	19.8	982
3. Deep soils developed on sandstone and shale:													
a. Well-drained, on shale and sandstone	0		6	42.9	8	57.1	0		0		0		14
b. Well-drained, on sandstone and shale	9	.2	2,239	54.6	1,522	37.0	317	7.7	2	(?)	28	.6	4,112
c. Imperfectly drained	0		125	57.3	47	21.6	21	9.6	17	7.8	8	3.7	218
Total, group 3	9	.2	2,370	54.6	1,577	36.3	338	7.8	19	.4	31	.7	4,344
4. Shallow soils developed on interbedded limestone, sandstone, and shale	3	.2	39	2.4	798	49.1	80	4.9	348	22.1	347	21.3	1,625
5. Soils on terraces:													
a. Well-drained	134	5.4	1,318	53.3	889	35.9	23	.9	26	1.1	63	3.4	2,473
b. Imperfectly drained	0		448	74.4	135	22.4	12	2.0	1	.2	0	1.0	672
Total, group 5	134	4.4	1,766	57.4	1,024	33.3	35	1.1	27	.9	63	2.9	3,145
6. Poorly drained soils on uplands and terraces	0		0		0		354	100.0	0		0		354
7. Alluvial soils:													
a. Well-drained	1,175	97.4	31	2.6	0		0		0		0		1,206
b. Imperfectly drained	0		699	100.0	0		0		0		0		699
c. Poorly drained	0		0		0		738	100.0	0		0		738
Total, group 7	1,175	46.2	730	24.8	0		738	29.0	0		0		2,643
8. Miscellaneous soils not suitable for cultivation	0		0		0		0		90	19.4	374	80.6	454
All idle land	1,321	4.0	4,843	14.5	12,068	36.2	3,354	10.1	4,642	13.6	7,190	21.6	73,268

See footnotes at end of table.

TABLE 3.—Capability of land for use, by soil groups, in Muskingum County.—Continued

PASTURE

Soil group	Area and proportion in land-capability class—												Total
	I (green) <sup>1</sup>		II (yellow) <sup>2</sup>		III (red) <sup>3</sup>		IV (blue) <sup>3</sup>		VI (orange) <sup>2</sup>		VII (brown) <sup>2</sup>		
	Acres	Percent (%)	Acres	Percent (%)	Acres	Percent (%)	Acres	Percent (%)	Acres	Percent (%)	Acres	Percent (%)	
1. Shallow soils developed on sandstone and shale or cherty limestone.....	42		161	0.2	32,070	37.6	5,227	6.1	18,865	22.1	28,915	34.0	85,250
2. Soils with heavy clay subsoils developed on shale and sandstone.....	3	.1	8	.2	2,367	47.2	184	3.7	1,262	25.2	1,185	28.0	5,009
3. Deep soils developed on sandstone and shale:													
a. Well-drained, on shale and sandstone.....	0		0		7	100.0	0		0		0		7
b. Well-drained, on sandstone and shale.....	11	.1	7,865	54.1	5,434	37.4	1,095	7.5	59	.4	79	.5	14,533
c. Imperfectly drained.....	0		821	54.7	317	21.1	291	19.4	37	2.5	34	2.3	1,500
Total, group 3.....	11	.1	8,676	54.1	5,758	35.9	1,386	8.6	96	.6	113	.7	16,040
4. Shallow soils developed on interbedded limestone, sandstone, and shale.....	31	.1	18	.1	12,714	48.5	766	2.9	8,029	30.6	4,607	17.8	26,225
5. Soils on terraces:													
a. Well-drained.....	267	3.8	3,351	47.3	2,900	41.0	53	.7	27	.4	481	6.8	7,079
b. Imperfectly drained.....	0		2,280	73.2	669	21.5	42	1.3	11	.3	116	3.7	3,118
Total, group 5.....	267	2.8	5,631	55.2	3,569	35.0	95	.9	38	.4	597	5.9	10,197
6. Poorly drained soils on uplands and terraces.....	0		0		0		2,209	100.0	0		0		2,209
7. Alluvial soils:													
a. Well-drained.....	3,655	93.1	272	6.9	0		0		0		0		3,927
b. Imperfectly drained.....	0		4,401	100.0	0		0		0		0		4,401
c. Poorly drained.....	0		0		0		4,498	100.0	0		0		4,498
Total, group 7.....	3,655	28.5	4,673	38.4	0		4,498	35.1	0		0		12,826
8. Miscellaneous soils not suitable for cultivation.....	0		0		0		0		833	18.0	3,797	82.0	4,630
All pasture.....	4,009	2.5	19,167	11.8	56,478	34.8	14,465	8.9	29,123	17.9	39,274	24.1	162,506

WOODLAND

1. Shallow soils developed on sandstone and shale or cherty limestone.....	17	( <sup>3</sup> )	24	( <sup>3</sup> )	10,466	16.4	6,540	10.2	8,898	13.9	38,109	59.5	64,054
2. Soils with heavy clay subsoils developed on shale and sandstone.....	0		0		309	22.7	155	11.3	122	8.9	781	57.1	1,367
3. Deep soils developed on sandstone and shale:													
a. Well-drained, on shale and sandstone.....	0		2	13.3	13	86.7	0		0		0		15
b. Well-drained, on sandstone and shale.....	8	.4	1,318	63.2	679	32.5	11	.5	11	.5	59	2.8	2,086
c. Imperfectly drained.....	0		39	34.8	68	60.7	0		5	4.5	0		112
Total, group 3.....	8	.4	1,359	61.4	760	34.4	11	.5	16	.7	59	2.6	2,213
4. Shallow soils developed on interbedded limestone, sandstone, and shale.....	8	.2	5	.1	1,223	24.1	555	11.0	1,375	27.1	1,899	37.5	5,065
5. Soils on terraces:													
a. Well-drained.....	48	3.7	496	38.1	268	20.4	2	.2	16	1.2	473	36.4	1,301
b. Imperfectly drained.....	0		180	61.8	50	20.3	2	.7	0		60	17.2	291
Total, group 5.....	48	3.0	676	42.5	325	20.4	4	.2	16	1.0	523	32.9	1,592
6. Poorly drained soils on uplands and terraces.....	0		0		0		396	100.0	0		0		396
7. Alluvial soils:													
a. Well-drained.....	1,915	66.5	69	8.5	0		0		0		0		1,984
b. Imperfectly drained.....	0		1,123	100.0	0		0		0		0		1,123
c. Poorly drained.....	0		0		0		919	100.0	0		0		919
Total, group 7.....	1,915	47.6	1,192	29.6	0		919	22.8	0		0		4,026
8. Miscellaneous soils not suitable for cultivation.....	0		0		0		0		344	6.1	5,326	93.9	5,670
All woodland.....	1,966	2.4	3,256	3.9	13,083	15.4	8,580	10.2	10,771	12.8	46,697	55.3	84,383

<sup>1</sup> Does not include 1,577 acres of mine pits, dumps, and quarries; 2,334 acres of water; and 10,894 acres of farmyards and urban areas.  
<sup>2</sup> Color distinguishing class on the maps accompanying this bulletin.  
<sup>3</sup> Less than 0.1 percent.

TABLE 4.—Capability of land for use, by soil groups, in Guernsey County

ENTIRE COUNTY

soil group	Area and proportion in land-capability class—												Total Acres
	I (green) 1		II (yellow) 2		III (red) 3		IV (blue) 4		VI (orange) 5		VII (brown) 6		
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	
1. Shallow soils developed on sandstone and shale or cherty limestone.....	43	(?)	83	0.1	46,502	33.0	15,538	11.2	13,974	10.1	62,347	45.0	138,467
2. Soils with heavy clay subsoils developed on shale and sandstone.....	0		207	1.6	5,667	4.1	1,370	10.8	1,704	18.4	3,740	29.5	12,007
3. Deep soils developed on sandstone and shale:													
a. Well-drained, on shale and sandstone.....	5	.1	1,078	22.5	3,142	65.6	460	9.8	38	.8	63	1.3	4,708
b. Well-drained, on sandstone and shale.....	0		2,377	38.2	3,755	60.2	81	1.3	3	(?)	13	.2	6,229
c. Imperfectly drained.....	0		801	66.5	401	33.3	2	.2	0		0		1,204
Total, group 3.....	5	(?)	4,256	34.8	7,298	59.8	552	4.5	41	.3	76	.6	12,238
4. Shallow soils developed on interbedded limestone, sandstone, and shale.....	6	(?)	63	.1	31,140	58.5	3,411	6.4	12,642	23.7	8,086	11.8	53,249
5. Soils on terraces:													
a. Well-drained.....	2	(?)	1,023	24.9	1,913	46.5	172	4.2	25	.6	977	23.8	4,112
b. Imperfectly drained.....	0		3,349	42.8	3,879	49.6	206	2.6	7	.1	382	4.9	7,423
Total, group 5.....	2	(?)	4,372	36.6	5,792	48.5	378	3.2	32	.3	1,359	11.4	11,985
6. Poorly drained soils on uplands and terraces.....	0		0		0		1,895	100.0	0		0		1,895
7. Alluvial soils:													
a. Well-drained.....	4,012	99.4	24	.6	0		0		0		0		4,036
b. Imperfectly drained.....	0		26,627	100.0	0		0		0		0		26,627
c. Poorly drained.....	0		0		0		11,874	100.0	0		0		11,874
Total, group 7.....	4,012	9.4	26,651	62.7	0		11,874	27.9	0		0		42,537
8. Miscellaneous soils not suitable for cultivation.....	0		0		0		0		4,801	9.8	47,022	90.7	51,823
Entire county 1.....	4,068	1.8	35,632	10.9	96,399	29.7	35,018	10.8	33,194	10.2	120,539	37.1	324,800

CROPLAND

1. Shallow soils developed on sandstone and shale or cherty limestone.....	24	(?)	42	0.1	20,216	54.2	6,069	16.3	2,267	6.1	8,671	23.8	27,209
2. Soils with heavy clay subsoils developed on shale and sandstone.....	0		112	3.3	2,198	65.3	268	8.0	258	7.6	532	15.8	2,308
3. Deep soils developed on sandstone and shale:													
a. Well-drained, on shale and sandstone.....	5	.2	777	20.4	1,917	65.2	220	7.5	9	.3	13	.4	2,941
b. Well-drained, on sandstone and shale.....	0		1,463	40.7	2,113	58.9	10	.3	0		8	.1	3,591
c. Imperfectly drained.....	0		874	69.6	249	30.2	2	.2	0		0		826
Total, group 3.....	5	.1	2,814	38.2	4,279	58.2	232	3.2	9	.1	18	.2	7,457
4. Shallow soils developed on interbedded limestone, sandstone, and shale.....	0		22	.1	12,657	78.7	914	5.7	1,813	11.3	679	4.2	16,048
5. Soils on terraces:													
a. Well-drained.....	2	.1	687	30.4	1,034	45.8	118	5.2	7	.3	412	18.2	2,260
b. Imperfectly drained.....	0		2,224	47.9	2,181	46.9	87	1.9	0		124	3.3	4,646
Total, group 5.....	2	(?)	2,911	42.1	3,215	46.6	205	3.0	7	.1	566	8.2	6,906
6. Poorly drained soils on uplands and terraces.....	0		0		0		1,127	100.0	0		0		1,127
7. Alluvial soils:													
a. Well-drained.....	2,041	99.6	9	.4	0		0		0		0		2,050
b. Imperfectly drained.....	0		13,171	100.0	0		0		0		0		13,171
c. Poorly drained.....	0		0		0		3,321	100.0	0		0		3,321
Total, group 7.....	2,041	11.0	13,180	71.1	0		3,321	17.9	0		0		18,542
8. Miscellaneous soils not suitable for cultivation.....	0		0		0		0		1,432	24.0	4,526	76.0	5,958
All cropland.....	2,072	2.1	19,081	19.7	42,565	44.1	12,136	12.6	5,796	6.0	14,992	16.6	66,432

See footnotes at end of table.

TABLE 4.—Capability of land for use, by soil groups, in Guernsey County 1—Continued

IDLE LAND

Soil group	Area and proportion in land-capability class—											Total Acres	
	I (green) 1		II (yellow) 2		III (red) 3		IV (blue) 4		VI (orange) 5		VII (brown) 6		
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres		Percent
1. Shallow soils developed on sandstone and shales or cherty limestone.....	0		6	(*)	3,718	33.0	2,170	19.3	776	6.9	4,598	40.8	11,268
2. Soils with heavy clay subsoils developed on shale and sandstone.....	0		22	1.6	509	37.4	277	20.4	136	10.0	416	30.6	1,360
3. Deep soils developed on sandstone and shale:													
a. Well-drained, on shale and sandstone.....	0		46	9.0	320	63.8	101	20.2	0		35	7.0	501
b. Well-drained, on sandstone and shale.....	0		154	31.3	310	63.0	28	5.7	0		0		492
c. Imperfectly drained.....	0		22	37.3	37	62.7	0		0		0		59
Total, group 3.....	0		221	21.0	667	63.4	129	12.3	0		35	3.8	1,052
4. Shallow soils developed on interbedded limestone, sandstone, and shale.....	1	(*)	4	1	1,265	42.5	465	15.4	734	24.2	538	17.8	3,027
5. Soils on terraces:													
a. Well-drained.....	0		49	20.5	87	36.2	19	6.7	1	.4	87	36.2	240
b. Imperfectly drained.....	0		158	40.8	211	54.5	10	2.6	1	.3	7	1.8	387
Total, group 5.....	0		207	33.0	298	47.5	29	4.2	2	.3	94	15.0	627
6. Poorly drained soils on uplands and terraces.....	0		0		0		83	100.0	0		0		83
7. Alluvial soils:													
a. Well-drained.....	176	97.2	5	2.8	0		0		0		0		181
b. Imperfectly drained.....	0		1,125	100.0	0		0		0		0		1,125
c. Poorly drained.....	0		0		0		1,717	100.0	0		0		1,717
Total, group 7.....	176	5.8	1,130	37.4	0		1,717	56.8	0		0		3,023
8. Miscellaneous soils not suitable for cultivation.....	0		0		0		0		307	11.6	2,283	88.2	2,590
All idle land.....	177	.8	1,590	6.9	6,477	28.1	4,867	21.1	1,955	8.5	7,964	34.6	23,030

PASTURE

1. Shallow soils developed on sandstone and shale or cherty limestone.....	18	(*)	25	(*)	18,230	31.0	6,375	10.9	6,701	11.4	27,426	46.7	58,775
2. Soils with heavy clay subsoils developed on shale and sandstone.....	0		69	1.2	2,321	40.0	570	11.5	803	13.8	1,944	33.5	5,807
3. Deep soils developed on sandstone and shale:													
a. Well-drained, on shale and sandstone.....	0		208	17.5	786	67.2	138	11.6	29	2.4	15	1.3	1,186
b. Well-drained, on sandstone and shale.....	0		630	34.7	1,136	62.5	41	2.3	3	.2	8	.3	1,818
c. Imperfectly drained.....	0		192	63.4	111	36.6	0		0		0		303
Total, group 3.....	0		1,030	31.1	2,043	61.8	179	5.4	32	1.0	23	.7	3,307
4. Shallow soils developed on interbedded limestone, sandstone, and shale.....	8	(*)	47	1	14,299	53.8	1,788	6.7	7,066	26.6	3,424	12.8	26,597
5. Soils on terraces:													
a. Well-drained.....	0		269	18.3	753	51.3	36	2.5	12	.8	397	27.1	1,467
b. Imperfectly drained.....	0		913	34.7	1,421	54.0	104	4.0	5	.2	188	7.1	2,631
Total, group 5.....	0		1,182	28.8	2,174	53.1	140	3.4	17	.4	585	14.3	4,098
6. Poorly drained soils on uplands and terraces.....	0		0		0		653	100.0	0		0		653
7. Alluvial soils:													
a. Well-drained.....	1,469	99.7	4	.3	0		0		0		0		1,473
b. Imperfectly drained.....	0		10,640	100.0	0		0		0		0		10,640
c. Poorly drained.....	0		0		0		5,721	100.0	0		0		5,721
Total, group 7.....	1,469	8.2	10,644	59.7	0		5,721	32.1	0		0		17,834
8. Miscellaneous soils not suitable for cultivation.....	0		0		0		0		1,848	10.4	15,950	89.6	17,798
All pasture.....	1,490	1.1	12,967	9.0	30,067	29.0	16,526	11.5	16,467	12.2	49,352	35.6	134,860

See footnotes at end of table.

TABLE 4.—*Capability of land for use, by soil groups, in Guernsey County*—Continued

WOODLAND

Soil group	Area and proportion in land-capability class—												Total Acres
	I (green) †		II (yellow) ‡		III (red) ‡		IV (blue) ‡		VI (orange) ‡		VII (brown) ‡		
	Acres	Percent (%)	Acres	Percent (%)	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	
1. Shallow soils developed on sandstone and shale or cherty limestone.....	1		10		4,338	13.9	924	3.0	4,240	13.6	21,652	69.6	31,136
2. Soils with heavy clay subsoils developed on shale and sandstone.....	0		4	.2	639	29.6	153	7.2	507	23.5	857	29.5	2,162
3. Deep soils developed on sandstone and shale:													
a. Well-drained, on shale and sandstone.....	0		48	28.7	109	65.3	10	6.0	0		0		167
b. Well-drained, on sandstone and shale.....	0		120	39.6	196	59.8	2	.6	0		0		328
c. Imperfectly drained.....	0		13	76.5	4	23.5	0		0		0		17
Total, group 3.....	0		191	37.3	309	60.4	12	2.3	0		0		512
4. Shallow soils developed on interbedded limestone, sandstone, and shale.....	2	(3)	20	.3	2,899	88.4	244	3.2	3,029	40.2	1,345	17.0	7,439
5. Soils on terraces:													
a. Well-drained.....	0		18	12.4	39	26.9	2	1.4	5	7.4	61	53.0	145
b. Imperfectly drained.....	0		54	34.0	66	41.5	5	3.1	1	.6	33	20.8	159
Total, group 5.....	0		72	23.7	105	34.5	7	2.3	6	2.0	114	37.5	304
6. Poorly drained soils on uplands and terraces.....	0		0		0		32	100.0	0		0		39
7. Alluvial soils:													
a. Well-drained.....	326	98.2	6	1.8	0		0		0		0		332
b. Imperfectly drained.....	0		1,691	100.0	0		0		0		0		1,691
c. Poorly drained.....	0		0		0		1,115	100.0	0		0		1,115
Total, group 7.....	326	10.4	1,697	54.1	0		1,115	35.5	0		0		3,138
8. Miscellaneous soils not suitable for cultivation.....	0		0		0		0		1,214	4.8	24,263	95.2	25,477
All woodland.....	329	.5	1,994	2.8	8,290	11.8	2,489	3.5	8,996	12.8	48,231	68.6	70,219

† Does not include 231 acres of mine pits, dumps, and quarries; 550 acres of water; and 5,880 acres of farmyards and urban areas.  
‡ Color distinguishing class on the maps accompanying this bulletin.  
§ Less than 0.1 percent.

A fourth of the cropland in Muskingum County and a third of that in Guernsey County should be removed from cultivation. Part of this land may be utilized for permanent pasture, but some of it should be reforested. The same proportions of the present pasture in the two counties are not suitable for pasture and should be reforested.

Adjustments in land use as vast as these create many problems. There is ample suitable land in each county as a whole to replace cropland taken out of cultivation but some of this land is now in permanent pasture or woodland. Clearing of woodland involves rather large expenditures of labor and money, and this plus the present return from the woodland must be balanced against the returns that could be obtained if the land was cleared for crops. Permanent pastures can be plowed for crops without too much difficulty but the more level pastures such as are found in classes I, II, and III are commonly more productive than those on the steeper, shallower lands. It will probably be necessary, however, to utilize some

of these better pastures for cropland in order to grow the necessary crops. Converting the cultivable pasture land and reforesting steeper pasture land will cut down pasture acreage considerably. Improvement of the remaining pastures and careful treatment of cropland converted to pasture will be necessary to bring up the carrying capacity in order to balance this loss of pasture acreage.

The large amount of idle land in the two counties constitutes a reserve, but not all this land can be safely used as cropland. Some of the idle land not suitable for cultivation can be used for pasture, but a large part of it should be reforested.

Land use adjustments in the two counties as a whole will be difficult to work out. Even more difficult will be the problem on individual farms. Many farms are now so laid out that they contain no land in classes I and II, and all the crops must be grown on class III land, which requires a great deal of care. There are also many farms in the southern part of these counties that contain nothing but land in capability classes IV, VI, and



VII. In such areas a rearrangement of farming units is called for. Some farmers may be able to buy or rent additional land on which to grow grain. Others may be able to change their type of farming. The farmer's preferences and aptitudes, his type of farming, and whether he owns or rents his farm all enter into the use of the land. Further consideration of these factors is, however, beyond the scope of this bulletin.

## Physical Features and Drainage

MUSKINGUM AND GUERNSEY Counties (fig. 2) are a part of a highly dissected plateau that makes up a part of the unglaciated Allegheny Plateau. Altitudes of ridge tops along the eastern boundary of Guernsey County range from about 1,200 to 1,320 feet, and those along the western boundary of Muskingum County from 900 to 1,000 feet. The lowest altitude in the two counties is 650 feet at the point where the Muskingum River leaves Muskingum County.

With the exceptions of two small areas in western Muskingum County that are described by Stout as being covered by Illinoian drift, both counties are unglaciated.<sup>1</sup> The several ice sheets that covered northern and western Ohio changed the drainage of Muskingum County but not that of Guernsey County. In preglacial times most of southeastern Ohio was drained to the westward and northward and thence through Fort Wayne, Ind.<sup>2</sup> The tributary streams in Muskingum County flowed in a northerly direction to the old master streams. These preglacial streams were dammed up by the glaciers and new drainage systems were then cut deeply into the land leaving the old floors high above the present valleys. These old valley floors are the present-day high terraces in Muskingum County.

Large amounts of sand, silt, and gravel outwash material were carried and deposited by the streams flowing from the ice front, and the present terraces along the main courses of the Muskingum and Licking Rivers and along Wills Creek below Plainfield in Coshocton County consist of glacial outwash material. The terraces in the tributary valleys not connected with the glacial front and of Wills Creek above Plainfield are of silt and clay derived from erosion of the uplands within each basin. They were deposited in the backwater when the major streams were blocked by ice.

The wide valley that crosses Case and Jackson townships and the northwestern part of Licking township is the valley of a river that flowed westward during the glacial period. The streams now in this valley, Wakatomika Creek and its tributary, Black Run, flow eastward into the Muskingum River.

The uplands of both counties are thoroughly dissected by streams and drainageways that have cut narrow V-shaped valleys. In general, the relief is rolling to steeply rolling and ridge tops are narrow. The most rugged relief is in the extreme southeastern part of Guernsey County, where the slopes are broken by a series of benches caused by differences in the resistance of bedrock to weathering and erosion. Similar but less steep relief is found in several places in the southern part of both counties

as far west as Poverty Ridge near Philo. More commonly, however, the slopes decline steeply but uniformly until they flatten out within a short distance of the flood plain or terrace. Slopes adjoining the smaller rapidly flowing streams commonly extend directly to the channel; there is no flood plain. A notable feature of many hillsides, particularly in eastern Guernsey County, is their billowy appearance caused by slips or landslides.

There are two large areas of more gentle relief in central and western Muskingum County near Zanesville. One of these extends from Adamsville southward through Sonora to a point about 5 miles south of U. S. No. 40. The other is in the triangle formed by the Muskingum River, the Licking River, and Black Run and Wakatomika Creeks. These are valleys of preglacial northward-flowing streams that eventually drained out through Newark. In these areas the ridges are at a somewhat lower altitude and have broad, nearly flat tops and gentle valley slopes.

Both counties are entirely within the drainage basin of the Muskingum River. Numerous tributary streams extend to all parts of the uplands. Muskingum County west of the Muskingum River is drained by Wakatomika, Jonathan, Moxahala, and Brush Creeks, and the Licking River. To the east of the Muskingum River, it is drained by Symmes and Salt Creeks, which empty into the Muskingum River, and by Meigs and White Eyes Creeks, tributaries of Wills Creek. Guernsey County is drained by Wills Creek and its numerous tributaries.

Surface drainage of the upland soils is good, and internal drainage is good except for some very level areas on ridge tops and a few seep spots on the hillsides. The terraces are mostly well or immediately drained. Most of the first bottoms, however, are only intermediately or poorly drained. The flood plains of the main streams—the Muskingum and Licking Rivers and Wills Creek—range from  $\frac{1}{2}$  mile to 2 miles in width. Those of the Muskingum River are broader in the northern part of Muskingum County than in the southern, which is an abnormal condition due to the former direction of drainage.

The total area of gently rolling uplands, of nearly level terraces, and of flood plains is not large but these are the important agricultural lands. The level land in Guernsey County is limited to the bottom land along the meanders of Wills Creek. The level land in Muskingum County is confined to the old valleys and the terraces and bottom lands along the Muskingum and Licking Rivers.

## Native Vegetation<sup>7</sup>

ALL THE ORIGINAL FOREST stands have been cut over and the present woodlands are second growth. The original forests were typical of the central hardwood-forest region. Oak-hickory forests grew on most of the ridge tops and much of the moderately sloping land. Forests composed almost entirely of white oak grew on some of the dry ridges, which were known as white-oak lands. On other dry ridges and steep slopes, mixed-oak forests in which there was some chestnut were dominant. Climax beech-maple forests, composed chiefly of beech but containing some sugar maple, were more common in western Muskingum County on the

<sup>1</sup> STOUT, W. GEOLOGY OF MUSKINGUM COUNTY. Ohio Geol. Survey Bul. (Ser. 4) 21, 331 pp., illus. 1918.

<sup>2</sup> STOUT, W., and LAMB, G. F. PHYSIOGRAPHIC FEATURES OF SOUTHEASTERN OHIO. Ohio Jour. Sci. 33: 49-63, illus. 1933.

<sup>7</sup> Based on a special-problem thesis on the original vegetation of Muskingum County prepared in 1937 for the Department of Botany, The Ohio State University, by Charles A. Dambach, associate biologist, Soil Conservation Service.

slopes of valleys where better moisture conditions prevailed. Mixed/mesophytic forests, consisting of yellow poplar, beech, white oak, black oak, and red maple, and subdominant trees such as chestnut, white ash, hickory, sugar maple, and black walnut, occupied slopes where the soils contain some limestone, and oak-chestnut forests the ridges above these slopes.

Swamp forests grew along the old valley floors in northwestern Muskingum County and in a few scattered poorly drained areas throughout the counties. Secondary swamp-forest trees such as swamp white oak, pin oak, big shellbark hickory, and black ash persist in these areas today.

A few small prairie openings occurred locally in spots where trees could not successfully become established. Big bluestem, little bluestem, and Indian grass were the characteristic prairie plants in these openings.

Wildlife was plentiful when the land was first settled. Deer, bear, wolves, foxes, raccoons, woodchucks, opossums, skunks, and squirrels were common, and the early settlers derived their meat from wild animals.

The common game and fur-bearing animals in the two counties today are cottontail rabbits, grey and fox squirrels, bobwhite quail, striped skunk, opossum, muskrat, and raccoon. Of less economic importance are the ring-necked pheasant, woodchuck, and a few migratory waterfowl.

## Economic Development

MUSKINGUM COUNTY was organized in 1804. The population has grown from 8,500 in 1810 to 69,795 in 1940. Zanesville (1940 population, 37,500), the county seat, is its chief trading point and an im-

portant center of gas, oil, and coal. It has a wide reputation for its clay products of tile, brick, and pottery. Other towns in the county are Philo, Roseville, New Concord, Dresden, and Trinway.

Guernsey County was organized in 1810 when its total population was 3,000. The population reached its peak of 45,352 in 1920, since when there has been a steady decrease to 38,822 in 1940. Cambridge, the county seat and chief trading point, had a population of 15,044 in 1940. Hyesville had 2,118 inhabitants and Quaker City, 634.

Coal and clay products are the chief sources of industrial income. Gravel deposits along the Muskingum River supply large quantities of sand for road building and construction purposes. Oil and gas occur in various parts of both counties.

The Baltimore and Ohio, the Pennsylvania, and the Wheeling and Lake Erie Railroads pass through both counties. U. S. No. 40, one of the most traveled roads in the country, crosses in an east-west direction, passing through both Cambridge and Zanesville. Hard-surfaced or graveled roads that are in good condition most of the year connect most of the important points. There are also some unimproved roads that are impassable to automobile traffic during the winter months. Bus lines operate on most of the improved roads, and the amount of freight and farm produce hauled by motortrucks has increased greatly.

School facilities are excellent in both counties. Over one-third of the farmers in Muskingum County and a little less than a third of those in Guernsey County had telephones in their homes in 1940. About a third of the Guernsey County farmers and over half of the Muskingum County farmers had electricity on their farms in 1940. Some farmers use the gas from wells on their farms for light and fuel.

TABLE 5.—Normal and extreme monthly, seasonal, and annual temperature and precipitation at Cambridge, Guernsey County, Ohio<sup>1</sup>

[Elevation, 850 feet]

Month	Temperature (46-year record)			Precipitation (48-year record)					
	Mean <sup>2</sup>	Absolute maximum	Absolute minimum	Mean	Greatest on record	Least on record	Greatest in any 24-hour period <sup>3</sup>	Average days with 0.01 inch or more	Average snowfall <sup>4</sup>
	°F.	°F.	°F.	Inches	Inches	Inches	Inches	Number	Inches
December	32.6	71	-18	3.06	6.42	0.58	1.62	5	4.1
January	30.6	70	-31	3.28	9.80	1.43	1.50	9	6.9
February	30.6	75	-33	2.43	5.92	.51	2.17	8	5.2
Winter	31.3	76	-33	5.77	14.25	4.35	2.17	25	16.2
March	41.2	86	-4	3.64	7.64	.14	2.55	9	3.1
April	50.5	90	8	3.14	8.80	1.24	2.42	10	1.0
May	60.7	95	23	3.59	7.15	.82	2.41	10	1.0
Spring	50.8	95	-4	10.37	17.35	5.23	2.55	29	4.1
June	69.1	99	32	4.01	5.25	1.25	3.69	9	.0
July	73.1	104	39	4.54	12.72	.51	7.02	9	.0
August	71.2	102	38	3.72	12.19	.97	2.62	8	.0
Summer	71.1	104	32	12.27	22.88	3.85	7.09	26	.0
September	65.5	98	27	2.99	10.04	.23	4.53	6	.0
October	53.7	90	14	2.60	9.16	(?)	2.30	7	.2
November	42.0	80	1	2.51	7.14	.87	1.90	7	1.2
Fall	53.7	96	1	8.00	18.00	2.91	4.53	20	1.4
Year	51.7	104	-33	39.41	49.25	20.90	7.09	99	21.7

<sup>1</sup> From U. S. Weather Bureau reports.

<sup>2</sup> 47-year record.

<sup>3</sup> 46-year record.

<sup>4</sup> 44-year record.

<sup>5</sup> Trace.

## Climate

THE CLIMATE IS CONTINENTAL in nature and there are great fluctuations in temperature and humidity. The winters are generally open with only a few days below zero, although a minimum temperature of  $-33^{\circ}$  F. has been recorded at Cambridge. There are frequent freezes and thaws. The mean winter temperature is  $31.3^{\circ}$ . Snowfall averages 21.7 inches a year, and snow does not usually lie on the ground for any great length of time. The summers are warm, and there are frequent periods of very hot weather lasting from a few days to a week or more. The mean summer temperature is  $71.1^{\circ}$ , and the maximum recorded is  $104^{\circ}$ .

The average length of the growing season at the United States Weather Bureau station at Cambridge, which lies at an altitude of 850 feet, is 153 days. The average date of the last killing frost at this station is May 7 and that of the first killing frost in the fall is October 7. There are some local variations in the length of the growing season throughout the counties owing in part to differences in altitude, air currents, and width and depth of valleys. The growing season at one Weather Bureau station at Philo located on the first bench above the river at 750 feet averages 166 days, and that of a station at Philo at an altitude of 1,018 feet averages 168 days.

The mean annual rainfall at Cambridge is 39.41 inches, but the amount has ranged from 20.90 inches in 1930, the driest year, to 49.26 inches in 1911, the wettest year. Rainfall is fairly well distributed throughout the year, although it is about 2 to 4 inches greater in the spring and summer than in the fall and winter.

Table 5 shows significant climatic data from the United States Weather Bureau station at Cambridge.

Intensity of rainfall and the season in which the intense rains occur are important in determining the amount of erosion that takes place. A recent analysis of erosive rains at the Northwest Appalachian Soil and Water Conservation Experiment Station at Zanesville, Ohio, shows that most of the erosive rains in this part of Ohio occur in May, June, July, and August.<sup>3</sup> Losses of soil equivalent to  $\frac{1}{2}$  ton or more per acre from a bare plot were recorded for 90 different rains in a total of 400 rains recorded in the 4 years from 1934 to 1937, during which the rainfall was about average. Although these rains accounted for only 61 percent of the total amount of rainfall in the 4 years, they caused 99 percent of the soil loss from the test plot. Of the 90 rains, 59 caused soil losses of 1 ton or more per acre, or 94 percent of the total soil loss. Of these 59 rains, 41 occurred in May, June, July, and August. The average 5-minute maximum intensity of these rains ranged from 2.17 inches to 4.32 inches per hour.

Although these results were obtained on an uncultivated bare plot, they indicate the trend of soil losses on lands with little or no protective cover. These heavy rains fall when corn is being planted and cultivated, and when pastures are apt to be overgrazed.

## Types of Farming and Land Use

THE EARLY FARMING was entirely self-sufficing. Corn, wheat, oats, rye, buckwheat, flax, tobacco, and hay were grown. A few sheep, cattle, and hogs were kept for home consumption. There was no definite rotation; corn followed corn year after year

on many fields, and wheat was grown exclusively on other fields. Tobacco assumed a position of some importance about 1825, and a tobacco factory was established in Muskingum County in 1830. Slightly over 1,000 acres of tobacco were grown in Guernsey County in the 1880's, but the acreage has decreased steadily until in 1940 less than three farms in either county reported any tobacco. At first flax was grown almost as extensively as corn but it has now disappeared from the agriculture.

Wheat was the leading source of farm income until the 1850's when there was a sharp reduction in acreage. This decline was due largely to the introduction of harvesting machinery, which gave the growers on the more level lands of the West a distinct advantage over those on the hilly lands of this section. Corn then became the principal grain crop, as it has been ever since.

The reduction in wheat acreage was accompanied by an increase in the production of sheep and beef cattle. Increasingly poor pastures, competition from the large grazing lands of the West, and reduction of the sheep flocks by internal parasites, however, had brought about a great reduction in the number of beef cattle and sheep by 1910.

Dairy cattle have become increasingly important with the greater accessibility to markets and the good returns to be received from dairy products. At the present time, both counties are chiefly livestock and dairy areas in which a general system of livestock-grain farming is followed, the grain being fed to the livestock. Sheep raising is still important, although the number of sheep has fluctuated considerably in recent years. Some farmers keep a large number of cattle and no sheep; others raise sheep, chiefly. Hogs were formerly raised for the market but their number has decreased steadily and now only enough for home needs are raised.

Table 6 shows the numbers of the principal livestock in Muskingum and Guernsey Counties in stated census years. Livestock and livestock products made up 88 percent of the gross cash agricultural income in 1930 in Guernsey County and 76 percent of that in Muskingum County.<sup>9</sup> Dairy products and beef cattle supplied the greatest part of this income; poultry, second; and sheep, third.

Table 7 gives the acreage devoted to the principal crops in the two counties in recent years and shows a general trend toward the reduction of grain acreage and the increase of hay acreage. Although the acreage of corn has remained more constant than that of any other crop over a period of years, a gradual decrease is apparent. The corn acreage in Muskingum County in 1939, which was 23,036 acres, is the smallest on record for the county, and that in Guernsey County, 15,611 acres, is one of the smallest recorded for the county.

Wheat acreage has declined steadily except for a few years during World War I. In 1939 that in Muskingum County was less than one-third and that in Guernsey County was about one-fifth of the average acreages for the 1850's.

Oats have never been of great importance but the acreage remained fairly constant until 1929. Then there was a sharp reduction, and in 1939 there were only 1,989 acres in Guernsey County and 1,449 acres in Muskingum County.

The acreage in hay and forage crops has increased steadily in both counties. Since 1900 the acreage of hay and forage crops in Guernsey County has exceeded that of all the cultivated crops combined. The acreage in hay and forage crops in Muskingum

<sup>3</sup> BORST, H. L., WOODBURN, R., and BAVER, L. D. THE FREQUENCY AND SEASONAL DISTRIBUTION OF EROSIIVE RAINS IN OHIO. Ohio Agr. Expt. Sta. Blno. Bul. 24, pp. 15-21, illus. 1940.

<sup>9</sup> BITTERLY, J. H., BAKER, R. H., and FALCONE, J. I. MAJOR LAND-USE PROBLEM AREAS AND LAND UTILIZATION IN OHIO. Ohio State Univ., Dept. Rural Econ., Bul. 79, 71 pp., illus. 1935. [Processed.]

TABLE 6.—Number of principal livestock in Muskingum and Guernsey Counties, Ohio, in stated years<sup>1</sup>

Year	Muskingum County				Guernsey County			
	Cattle	Sheep	Horses	Swine	Cattle	Sheep	Horses	Swine
1910.....	Number 27,764	Number 138,049	Number 19,502	Number 17,672	Number 20,037	Number 100,186	Number 6,514	Number 14,543
1920.....	30,901	88,730	9,335	21,306	24,751	54,115	7,148	12,070
1925.....	28,442	75,883	7,384	13,210	22,331	46,142	6,800	8,744
1930.....	26,589	87,364	5,963	14,089	25,420	43,749	4,840	7,150
1935.....	30,047	84,137	8,724	10,135	28,240	33,418	4,741	3,657
1940.....	20,846	55,514	8,208	10,081	24,037	33,660	4,404	8,768

<sup>1</sup> U. S. censuses.

TABLE 7.—Acreage devoted to the principal crops, in stated years<sup>1</sup>

Crop	Muskingum County						Guernsey County					
	1900	1919	1924	1929	1934	1939	1909	1919	1924	1929	1934	1939
Corn.....	Acres 33,306	Acres 32,413	Acres 26,171	Acres 26,462	Acres 28,334	Acres 23,036	Acres 22,392	Acres 19,768	Acres 14,344	Acres 18,401	Acres 17,605	Acres 15,411
Oats.....	8,961	7,413	4,623	4,525	1,623	1,419	8,307	8,667	5,165	5,337	2,511	1,660
Wheat.....	21,656	31,854	12,400	12,460	15,413	12,763	12,252	17,024	5,237	4,765	7,427	7,229
Hay and forage.....	57,237	52,495	56,395	44,007	43,645	36,973	40,431	42,846	48,081	38,987	40,028	37,040
Timothy or timothy and clover.....	55,220	49,418	51,176	34,820	37,649	29,914	48,428	40,886	44,007	33,736	32,048	27,052
Alfalfa.....	182	924	1,137	1,467	2,920	5,479	57	209	283	456	907	2,445

<sup>1</sup> U. S. censuses.

County has exceeded that in any one cultivated crop since 1890, and in 1939 exceeded that of all cultivated crops combined. The hay crops are principally timothy and clovers. Although very little alfalfa was grown before 1924, since then its acreage has increased rapidly. The alfalfa acreage in Muskingum County in 1939 was almost double that of 1934; that in Guernsey County was more than double the 1934 acreage.

Most of the crops are fed to livestock; only a small part is sold. There are, however, many farms along the stream bottoms, particularly along the Muskingum and Licking Rivers, which grow truck crops to be sold in nearby towns or at roadside markets.

Table 8 shows the farm land in the two counties classified according to use as given in the last four

census reports. There were 2,767 farms in Guernsey County in 1940, and 3,381 farms in Muskingum County. These ranged in size from 3 acres to 1,000 acres, but over half were from 70 to 179 acres. Only 20 farms contained more than 500 acres. The average size is about 100 acres. Near the towns in both counties, but particularly in Muskingum County, there are many farms of less than 10 acres that are operated as subsistence homesteads. Most of the cash income of the operators of these farms comes from outside sources.

According to the census, the average value per acre of land and buildings in 1940 was \$37.20 in Muskingum County and \$24.53 in Guernsey County. The value of land and buildings, however, is much higher for farms on the well-drained

TABLE 8.—Farm acreage and classes of farm land according to use in stated years<sup>1</sup>

Class	Muskingum County				Guernsey County			
	1924	1929	1934	1939	1924	1929	1934	1939
Approximate land area.....	Acres 424,960	Acres 424,960	Acres 424,960	Acres 426,860	Acres 331,520	Acres 331,620	Acres 331,620	Acres 338,160
Land in farms.....	358,322	351,688	366,553	330,142	285,879	276,168	301,608	277,113
Average size of farm.....	90.0	107.8	96.2	97.6	96.4	104.4	96.0	104.4
Farm land according to use:								
Cropland, total.....	118,667	115,181	110,845	99,815	83,266	60,509	81,337	77,707
Harvested.....	104,474	93,299	95,498	81,414	77,520	69,271	72,438	65,606
Crop failures.....	1,798	1,692	2,926	2,011	1,093	1,545	2,431	1,910
Idle or fallow.....	12,395	16,190	12,421	16,390	4,653	9,693	6,468	10,392
Pasture land, total.....	198,966	197,220	219,843	.....	169,724	163,391	193,187	.....
Plowable.....	121,871	92,970	90,055	112,644	120,725	96,760	85,390	90,760
Woodland pasture.....	25,598	23,137	27,772	.....	18,920	21,819	20,920	.....
Other pasture.....	51,577	79,123	102,036	.....	30,061	44,622	76,867	.....
Woodland, not in pasture.....	15,473	16,425	15,510	37,737	19,833	18,227	18,608	21,927
All other land in farms.....	26,226	27,162	23,335	79,045	12,624	14,041	13,116	74,222

<sup>1</sup> U. S. censuses.

<sup>2</sup> Change due to remeasurement.

<sup>3</sup> Includes land planted for soil improvement or the prevention of erosion but not harvested.

<sup>4</sup> Includes woodland pastured.

<sup>5</sup> Includes land formerly reported as "other pasture."

bottom lands, terraces, and smooth uplands, and these forms may bring two, three, or even four times the average values.

The 1940 census shows 14.2 percent of the farms in Guernsey County and 17.7 percent in Muskingum County operated by tenants. Neither county is especially suited to a tenant system of farming because it is necessary to invest in livestock if the large pasture acreage is to yield appreciable returns. Most prospective tenants lack the necessary capital for this investment. Rental is either for cash, which ranges from \$1.50 to \$2.25 an acre, or a share of the crops.

With the exception of a few sod waterways, most of which were too narrow to prevent side cutting, there were no erosion-control measures in use in either county before the establishment of a soil conservation demonstration project at Zanesville. There were few planned rotations, although continuous cropping to the same crop had practically disappeared. The common practice of plowing up the least productive meadows for cropland has resulted in a variety of rotations on any one farm. Actually, the rotations followed range from a 2-year rotation of corn and small grain to a 5- or 6-year rotation of corn and small grain followed by 3 or 4 years of hay. The length of rotation is largely governed by the productivity of the meadows. Shorter rotations are usually followed on fields of low fertility and a high lime requirement. Although fair yields of corn and small grain are obtained on these fields, hay yields are poor even under the most favorable weather conditions. Consequently, hay is cut only 1 year, and the field is then replowed for grain.

## The Soil Conservation Survey

THE SOIL CONSERVATION SURVEY is a detailed inventory of the physical factors of soil type, slope, and erosion, shown in relation to each other and to present land use. The surveyor walks over the land, examines the soil frequently by making borings with an auger, and measures the slope with a hand level. He determines the amount of erosion that has taken place and then delineates on a base map each natural land area that is large enough to have practical significance in the use of the land. Aerial photographs were used as the base map for the survey of Muskingum and Guernsey Counties.

The maps that accompany this bulletin are on the scale of 1 inch to the mile. Soil type, slope, and erosion are shown by brown boundary lines and symbols. Each area delineated is designated by a composite symbol such as 3C37 that shows: By number the soil type, 3, Muskingum silt loam; by letter the slope, C; and by number the existing kind and degree of erosion, 37. An overprint of gray symbols shows the land use at the time of the survey. The land-capability classes determined by the soil, slope, and erosion conditions are shown by colors. The base map shows streams and ponds in blue, and highways, railroads, towns, occupied buildings, churches, schools, cemeteries, and other cultural features in black. County, township, and section lines are also shown in black.

Thus, any farmer can locate his farm on the map, and read from it the existing conditions of soil type, slope, and erosion, and the resulting capability of his land. By referring to the recommendations for the land-capability classes (pp. 5-25) and table 2 (pp. 7-9), he can determine the recommended land uses, desirable rotations, and supporting practices applicable to his farm.

The soils of Muskingum and Guernsey Counties have been developed under a deciduous forest cover in a humid, temperate climate. With one exception, the upland soils have been formed on residual material developed in place from the underlying bedrock, which is dominantly interbedded sandstone and shale. Thin beds of limestone crop out in southeastern Muskingum County, southern Guernsey County, and other scattered areas, and the soils in these areas have been formed on material developed from interbedded limestone, shale, and sandstone. One upland soil has been developed on glacial till deposited by the melting of the Illinoian glacier.

The soils on the terraces and flood plains have been developed on material deposited by the streams. Most of the sediments have been derived from the surrounding hills, but the soils along the Muskingum and Licking Rivers and Wakatomika Creek have been developed on glacial outwash or sediments carried and deposited by streams flowing from the ice front during the glacial period.

Cropping and leaching have removed the small amount of lime present in the upper layers and most of the soils in the two counties are acid. Where they have been developed on interbedded limestones, shales, and sandstone, or where they are periodically overflowed by water from the limestone uplands, as are some of the alluvial soils, the soils are only slightly acid or neutral to slightly alkaline.

Sixty soil types, classified in thirty-seven series, and two miscellaneous land types were mapped in the survey. Although the characteristics of each soil type are distinct, those that affect land capability and control of erosion may be conveniently considered if the soils are grouped in eight major groups. Brief discussions of the groups are given in the following paragraphs. A more detailed description of each soil type is given in the Appendix, table 16. The extent of each soil type in each county, the distribution of slope, erosion, present land use, and the capability for use of each soil are summarized in the Appendix, table 17.

### GROUP 1. SHALLOW SOILS DEVELOPED ON SANDSTONE AND SHALE, OR CHERTY LIMESTONE

Group 1 is the most extensive group of soils in either county and occupies 54 percent of Muskingum County and 43 percent of Guernsey County. It includes Frankstown cherty silt loam and Muskingum loam, silt loam, and silt loam, colluvial phase. Of these Muskingum silt loam is the most extensive.

The surface layers of these soils are grayish brown under forest cover and when first cultivated. Erosion has removed some of the surface layer, however, and most cultivated fields are now yellowish brown. The subsoils are yellowish brown and only slightly compact, although the subsoil of the Frankstown is somewhat more compact than that of the Muskingum. Numerous chert fragments from the underlying cherty limestone are scattered throughout the Frankstown and numerous sandstone and shale fragments throughout the Muskingum soils, which have been developed on sandstone and shale. Depth

<sup>10</sup> More complete descriptions and productivity ratings of some of the soils in Muskingum and Guernsey Counties may be found in CONREY, G. W., PASCHALL, A. H., and BURRAGE, E. M. A KEY TO THE SOILS OF OHIO. Ohio Agr. Expt. Sta. Spec. Cir. 44, rev., 51 pp., illus., 1937; and in the following soil survey reports published by the U. S. Bureau of Chemistry and Soils in cooperation with the Ohio Agricultural Experiment Station: Muskingum County (1925); Licking County (1930); Washington County (1926); and Belmont County (1927).

to the underlying material exceeds 3 feet in only a few places.

These soils occur on a wide range of slopes—smoothly rolling, bumpy, irregular, and very steep. Drainage is well established throughout the surface and subsoil layers and the underlying material, and the soils are likely to be droughty in midsummer dry periods. They are not naturally fertile and have become further depleted of organic matter and nutrients through cropping and erosion. Heavy applications of manure and fertilizers are necessary for even moderate yields of the customary crops. The Muskingum soils are strongly acid throughout and must be heavily limed for clovers or alfalfa. Hay and pasture stands are usually sparse and of poor quality. Legumes and grasses grow somewhat better on the Frankstown soil, which is less acid owing to the presence of limestone.

The steep slopes and the poor hay and pasture stands have contributed much to the erosion evidenced everywhere on these soils. Because they are not very deep any loss of soil is extremely serious. Sheet erosion has been particularly severe on the Muskingum soils, and both surface and subsoil material have been removed from many areas, exposing the underlying rotten sandstone and shale. This material is not a good medium for crops, pasture, or trees, and it is difficult to establish any kind of protective cover on it. Gullies are numerous but are not deep since cutting is stopped once bedrock is reached.

#### GROUP 2. SOILS WITH HEAVY CLAY SUBSOILS DEVELOPED ON SHALE AND SANDSTONE

Eifort silt loam, Meigs silty clay loam, Rarden silt loam, and Upshur clay are the soils in group 2, which makes up only 2 percent of Muskingum County and 4 percent of Guernsey County.

Meigs silty clay loam is the most extensive soil in this group. It is a complex of the grayish- to yellowish-brown Muskingum silt loam and red Upshur clay. It is extremely variable owing to differences in the relative proportions of the two soils, and no definite soil profile has been developed. In some places the soil is an intimate mixture of the two soils. In others, it consists of small scattered areas of Upshur clay in large areas of Muskingum silt loam. It generally occurs on very broken, irregular slopes.

Upshur clay has been developed on red clay shales and has a reddish-brown surface soil underlain by a heavy red clay. It occurs on somewhat smoother areas than Meigs silty clay loam. In many areas nearly all the surface soil has been removed by erosion, exposing the red clay subsoil.

The surface soil of Rarden silt loam resembles that of Muskingum silt loam of group 1, but the subsoil is heavier and is a variegated red, yellow, and gray silty clay loam. The depth to the underlying shale and sandstone is greater than in the Muskingum soils.

Eifort silt loam is characterized by a layer of gray fine clay at 20 to 30 inches below the surface. The surface soil resembles that of the Muskingum silt loam. The yellowish-brown subsoil is heavier than that of the Muskingum soils and grades into a gray clay stained by products leached from the overlying material.

All these soils are characterized by a heavy subsoil that retards internal drainage, although surface drainage is usually good. This heaviness not only retards percolation of water but makes the soils very susceptible to slipping. Once saturated with water, great masses of the semifluid soil material move downhill. Gullies cut rapidly into the un-

resistant shaly underlying material. These soils occur mainly on slopes of less than 30 percent, but there are some areas of very steep slopes. They erode rapidly unless maintained under a protective cover.

The heaviness of these soils makes them difficult to cultivate, and they tend to become hard and break into clods on drying out. All are acid, and the Eifort and Rarden soils are strongly acid. Lime is required for clovers and alfalfa. Although they are slightly more fertile than the soils of group 1, they must be manured and fertilized heavily for moderate to good yields. About half of their total area is now in pasture and about one-fourth is in cropland.

#### GROUP 3. DEEP SOILS DEVELOPED ON SANDSTONE AND SHALE

Group 3 includes all the deeper upland soils developed on sandstone and shale. These soils occur on the gentle slopes and gently rolling ridge tops on which the soil-forming material has accumulated to considerable depths. Few slopes exceed 20 percent and most of them are less than 12 percent. In these soils a deeper and more distinct subsoil has been developed than in the shallow soils of groups 1 and 2. The group has been divided into three subgroups on the basis of the natural drainage and the material on which the soils have been developed.

Group 3a consists of three well-drained soils in which the underlying material is dominantly shale. It includes Coolville silt loam and Guernsey silt loam, mapped in both counties, and Keene silt loam, mapped in Guernsey County only. These soils are very limited in extent.

Guernsey silt loam is the most extensive of the three soils. Its grayish-brown to yellowish-brown surface soil is underlain by a yellow to brownish-yellow compact silt loam that grades into a brownish-yellow silty clay loam mottled with gray below 18 inches. At 24 inches, the lower subsoil is an olive-yellow, heavy blocky clay that has a slight greenish-gray tinge. Below 40 to 50 inches is the parent material of weathered calcareous yellowish-gray shales intermixed with a poor grade of limestone and some sandstone. The surface soil is acid, but the subsoil is slightly alkaline owing to the calcareous parent material.

Coolville silt loam has been developed on red and gray clay shales, and the grayish-brown surface soil is underlain by a variegated red and yellowish-brown silty clay loam mottled with gray that grades into a reddish-brown to red heavy silty clay to clay. Keene silt loam has been developed on noncalcareous shales and some sandstone. This soil resembles Eifort silt loam of group 2, but the depth to the underlying clayey material is greater. Both soils are acid throughout.

Surface drainage of the soils of group 3a is good. The internal drainage is somewhat retarded by the heaviness of both the subsoil and the underlying material. About half their area is in cropland and about a fourth in pasture. Guernsey silt loam is the most productive, owing to the presence of limestone. Erosion has not been particularly severe on these soils mainly because of their position, but steeper areas will erode rapidly unless a protective cover is maintained.

Group 3b consists of Hanover, Wellston, and Zanesville silt loams, well-drained soils developed on material that is predominantly sandstone. It makes up 10 percent of Muskingum County and 2 percent of Guernsey County.

Wellston silt loam is the most extensive of these soils. It is similar to Muskingum silt loam but has

a deeper profile. The grayish-brown silt loam surface soil is 10 to 12 inches thick and is underlain by about 24 inches of brownish-yellow slightly heavy silty clay loam in which sandstone and shale fragments are scattered. This is underlain by a mixture of silty material and sandstone and shale fragments which continues until bedrock is reached at about 4 feet.

Zanesville silt loam is similar to Wellston silt loam in surface and subsoil layers, but the subsoil is less heavy and is free of sandstone and shale fragments. A definite layer of stone-free silty material lies between the subsoil proper and the bedrock of sandstone and shale which occurs at depths of 40 to 60 inches.

Hanover silt loam differs from all the other upland soils in origin. It has been developed on glacial drift and was mapped in Muskingum County only in the small areas described on page 32 as being covered by Illinoian drift. It is very similar to Wellston silt loam in most respects. The grayish-brown surface soil, 6 to 8 inches thick, is underlain by a yellowish-brown to light-brown, moderately heavy and moderately compact silt loam subsoil. Rounded pebbles and rock fragments occur throughout the subsoil and are more abundant with depth until the more or less unweathered glacial drift is reached at 40 to 50 inches.

All these soils are acid throughout and must be limed and fertilized for good yields and good pasture stands. They comprise the best agricultural soils of the uplands, ~~more because of~~ their depth and gentle surface relief than because of inherent fertility. Nearly half of their area is now used for crops, and about a third is in pasture. They have not been as severely eroded as the shallow soils that occupy the steeper slopes and are not subject to much slippage. Once started, however, gullies cut to considerable depths and commonly extend into the friable underlying material.

One soil type, Tilsit silt loam, makes up group 3c, which occupies less than 1 percent of either county. Tilsit silt loam occurs on nearly flat areas in the uplands. The gray to brownish-gray surface soil is underlain by a yellowish-brown heavy silt loam that becomes mottled and compact at 16 to 20 inches. The underlying material is sandstone and shale. The surface drainage is fair to good but the internal drainage is only fair, owing to the slowly pervious compact layer in the subsoil. It is a late soil in the spring and likely to be droughty in midsummer. In normal years moderate crop yields are obtained, but in very dry or very wet years yields are very poor. Most of the soil is used for hay and pasture. Lime and fertilizer are essential to good stands.

Tilsit silt loam has not been severely eroded because of its position on gentle slopes, but the compact, slowly pervious layer provides a hard surface from which the surface soil is easily removed.

#### GROUP 4. SHALLOW SOILS DEVELOPED ON INTERBEDDED LIMESTONE, SANDSTONE, AND SHALE

The soils in group 4 have been developed over alternate thin beds of limestone, calcareous and acid shales, and sandstone. They make up 11 percent of Muskingum County and 16 percent of Guernsey County. The soil types included are Belmont, Brooke, and Westmoreland silty clay loams, and Westmoreland silty clay loam, colluvial phase. They occur principally in the southern part of the two counties but also in scattered areas throughout the remainder of the uplands. They generally occupy rolling narrow ridge tops and rolling to steep

slopes in country broken by narrow ridges and steep V-shaped valleys. The hillsides are marked by successive short benches, which give a billowy appearance to the landscape.

Brooke silty clay loam has been developed on limestone and calcareous shales. The brown to dark-brown surface soil is underlain by an olive-yellow heavy blocky clay. The soil is only slightly acid and is productive, particularly for alfalfa, hay, and pasture.

Belmont silty clay loam is a complex of areas of Muskingum, Brooke, and Upshur soils too closely intermingled to be mapped out on the scale used in the survey. From place to place it is extremely variable in color from brown to grayish-brown, yellowish-brown, or reddish-brown, and in texture from a heavy silt loam, silty clay loam, or clay. Depth to underlying material is also variable and in some areas the soil is quite shallow.

Westmoreland silty clay loam, which is the most extensive soil in this group, is a complex of Muskingum silt loam and Brooke silty clay loam with many gradations in the relative proportions of the two soils. As in the Belmont soil, texture, color, and depth of the surface soil and subsoil are extremely variable. The colluvial phase was mapped at the base of slopes and occupies a less steep position than the typical Westmoreland. It is even more intermixed and is a little deeper.

Surface drainage of these soils is good and internal drainage is usually good although the subsoils are somewhat heavy. They are all less acid than the other upland soils, owing to the presence of limestone, but the reaction varies from place to place. They usually support excellent hay and pasture stands and over half their area is in pasture. Much of the cattle- and sheep-raising industry is centered on these soils. They are naturally somewhat more fertile than the other upland soils, and about a fourth of their area is in cropland. They are subject to severe erosion when cultivated, and gullies are numerous and rather deep because of the weakness of the underlying material. They are particularly susceptible to slip erosion, and the peculiar bumpy appearance of many hillsides is due to these slips or landslides.

#### GROUP 5. SOILS ON TERRACES

The terrace soils, group 5, have been divided into two subgroups on the basis of drainage. Group 5a includes soils of the Chenango, Holston, Elk, and Vincent series, all of which are well drained. They occupy 7 percent of Muskingum County and 1 percent of Guernsey County.

Chenango soils have been developed on glacial outwash material deposited along the Licking and Muskingum Rivers and Wakatomika Creek. The mellow brown surface soils are underlain by yellowish-brown subsoils that are in turn underlain by stratified sands and gravels. Textures mapped were gravelly loam, sandy loam, and silt loam, deep phase.

The Holston soils are underlain by laminated sands, silts, and clays washed from the Muskingum uplands. The loam, sandy loam, and silt loam textures were mapped. High-terrace phases of the loam and silt loam are old preglacial terrace or alluvial soils and are more weathered and more dissected by the present streams than the lower lying terraces. The surface soils of the Holston series are brown to yellowish brown and the subsoils are yellowish brown.

Elk silt loam has been developed on terraces where the deposits contain some limestone and were derived from the Westmoreland and Brooke uplands. The underlying material consists of laminated sands,

silts, and clays. The brown surface soil is underlain by a yellowish-brown, fairly heavy subsoil.

Vincent silt loam has been developed on deposits washed chiefly from the Meigs and Upshur uplands. The underlying material is laminated reddish clay and silt. The brown to grayish-brown surface soil is underlain by a yellowish-brown upper subsoil that rests on a dark red clay. Both the Elk and Vincent silt loams were mapped only in Guernsey County.

The Chenango, Holston, and Vincent soils are moderately to strongly acid and Elk silt loam is neutral or slightly acid. These soils occupy nearly level to gently undulating areas; only in a few places are the slopes more than 12 percent except where the terraces break to the first bottoms. Because of their position they are not subject to much erosion except where water from the uplands pours over them. Once started, however, gullies cut deeply into the friable underlying material. They are cultivated widely and are highly prized for general farming. Most of the truck crops are grown on these soils, particularly on the Chenango soils. Although the terrace soils are not much eroded, good management practices must be used to keep up their productivity.

Group 5b, imperfectly drained soils on terraces, includes Braceville, Captina, and Monongahela silt loams and the high-terrace phase of Monongahela silt loam. They occupy 2 percent of Muskingum County and 4 percent of Guernsey County.

Braceville silt loam is associated with the Chenango soils and has been developed on glacial-outwash material. Captina silt loam is associated with the Elk silt loam and has been developed on material washed from the Westmoreland uplands. A few small areas of a more poorly drained associate, Robertsville silt loam, are included with Captina silt loam. These areas are shown on the map by seep symbols in addition to the number used for Captina. The Monongahela soils are associated with the Holston soils and have been developed on silts and clays washed from the sandstone and shale, or Muskingum, uplands.

These soils resemble their better drained associates, but the heavier subsoils are mottled with gray or gray and yellow at depths of 15 to 20 inches. Surface drainage is fair but internal drainage is impeded by the heavy subsoils. The subsoil of the Monongahela soils becomes quite compact at 20 to 24 inches. The Braceville and Monongahela soils are strongly acid and the Captina is slightly to moderately acid.

The soils in this group occupy the more nearly level parts of the terraces, and erosion is not generally much of a problem. They are used mainly for cropland in association with the better drained terraces, but the A slopes usually require some supplementary drainage. Heavy applications of lime and fertilizer are necessary. They warm up later in the spring and are used more extensively for pasture than their better drained associates.

#### GROUP 6. POORLY DRAINED SOILS ON UPLANDS AND TERRACES

One upland soil, Mullins silt loam, and two soils on terraces, Blago silty clay loam and Tyler silt loam, are included in this group, which occupies about 1 percent of each county. These soils lie mainly on slopes of less than 5 percent.

Mullins silt loam is a poorly drained soil associated with the Tilsit, Wellston, and Muskingum soils. It occupies small, scattered, very flat or depressed areas in the uplands and streamheads and is not extensive. The gray to slightly brownish-gray sur-

face soil is underlain by a light gray silt loam in which numerous irregularly shaped yellowish-brown concretions are scattered. A dense, compact, impervious layer mottled with yellow and gray occurs at 24 to 36 inches. The soil is very strongly acid and that coupled with poor drainage makes it unproductive. Most of its small area is cropped with surrounding soils, but it must be drained for even fair yields. Its best use lies in hay and pasture.

Blago silty clay loam was mapped in poorly drained areas on the high terraces along the old valley in northwestern Muskingum County. It differs from most of the other soils in having been developed under a grass cover rather than under trees. It is much darker in color, the surface soil being grayish-black, contains more organic matter than the other terrace or upland soils, and is consequently very productive if adequately drained. Numerous concretions throughout the soil give it a "buckshot" appearance. It is strongly acid and must be heavily limed for clovers or alfalfa. It is an especially good corn soil if drained, and tile drainage would be both economical and effective.

Tyler silt loam is the poorly drained associate of the Holston and Monongahela soils and is very strongly acid. Some very poorly drained areas are also included. Tyler silt loam has a characteristically gray color and the heavy, compact subsoil is mottled with yellowish-brown and gray. It is used largely for pasture. Some areas are cultivated but with poor results, and tile drainage is not considered economical.

These soils are not subject to much erosion because of their position on nearly level or depressed land.

#### GROUP 7. ALLUVIAL SOILS

This group includes all the soils on the first bottoms. It has been divided into three subgroups on the basis of present drainage conditions.

Group 7a consists of the well-drained alluvial soils and includes soils of the Huntington, Chagrin, Moshannon, and Pope series. They occupy 5 percent of Muskingum County and 1 percent of Guernsey County. The Huntington soils have been formed on deposits derived mainly from the uplands that contain some limestone. They are mellow, brown to dark brown in color, and slightly acid to slightly alkaline in reaction. Textures mapped in the survey are fine sandy loam, sandy loam, loam, and silt loam. A high-bottom phase of the silt loam was mapped on bottoms of sufficient altitude to be free from overflow.

The Chagrin soils have been developed on deposits derived chiefly from glaciated shale and sandstone upland soils influenced to some extent by limestone. They are mapped on the main bottoms along Wakatomika Creek, the lower part of the Licking River, and the upper part of the Muskingum River. The headwaters of these streams are in the glaciated lands to the north and west of Muskingum County. Textures mapped are fine sandy loam, loam, and silt loam.

Moshannon silty clay loam occurs on bottoms that receive deposits washed from the Meigs, Upshur, and Belmont uplands. It is reddish brown in color, owing to the influence of the red Upshur clay, and of heavier texture than the Huntington soils. It is neutral to slightly alkaline.

The Pope soils occur along streams draining the sandstone and shale uplands. They are brown to yellowish brown in color and acid in reaction. Textures mapped in the survey are fine sandy loam, sandy loam, loam, and silt loam.

These well-drained alluvial soils are the most productive in the two counties and are easily cultivated.



They are subject, however, to occasional spring overflows that may wash out a corn crop and to occasional winter floods that may destroy winter grain. Some large areas of these soils occur along the major streams but the flood plains are commonly rather narrow. These soils are used extensively for cultivation where they occur in large enough areas. They are not subject to erosion.

Group 7b includes the imperfectly drained soils of the Lindside, Lobdell, Philo, and Senecaville series. They make up 2 percent of Muskingum County and 8 percent of Guernsey County.

Lindside silt loam occurs mainly along Wills Creek and along the secondary streams draining the mixed limestone, sandstone, and shale uplands. It is brown to grayish brown mottled with light gray, rust brown, and yellow below 15 to 18 inches. It is neutral to slightly alkaline in reaction.

Lobdell silt loam is the imperfectly drained soil associated with the Chagrin soils. It is similar to Lindside silt loam in characteristics and reaction.

Soils of the Philo series occur mainly along the secondary streams that drain the sandstone and shale uplands. They are acid in reaction and mottled with brown, gray, and rust brown below 15 or 18 inches. Loam and silt loam textures were mapped.

Senecaville silty clay loam is the imperfectly drained soil associated with Moshannon silty clay loam. It is grayish brown with a reddish cast and is mottled with yellow and gray below 15 to 18 inches. It is neutral to slightly alkaline in reaction.

These soils are cultivated in conjunction with their better drained associates, but they are not as productive because of their imperfect drainage and susceptibility to frequent overflow. Tiling or ditching would improve yields. They are used extensively for pasture. Erosion is not a problem on these nearly level lands.

Group 7c includes the very poorly drained alluvial soils of the Atkins, Holly, and Melvin series and makes up 9 percent of Muskingum County and 18 percent of Guernsey County. Melvin silt loam is associated with the Huntington and Lindside soils and is brownish gray mottled with light gray, yellow, and rust brown. Holly silt loam is associated with the Chagrin and Lobdell soils and is gray to grayish brown mottled with rust brown and yellow. Both are moderately acid in reaction. Atkins silt loam is gray mottled with rust brown, dark gray, and yellow, and is strongly acid in reaction.

These soils are poorly drained throughout. Water stands on them for considerable periods and ridges and tussocks are the usual vegetation. They are too poorly drained for regular cultivation.

#### GROUP 8. MISCELLANEOUS SOILS NOT SUITABLE FOR CULTIVATION

This group includes Muskingum stony loam, Muskingum stony silt loam, and stony land, Muskingum soil material. These types make up 3 percent of Muskingum County and 16 percent of Guernsey County. They occupy the very steep hillsides and were mapped almost entirely on slopes over 20 percent, mostly over 30 percent.

Muskingum stony loam and stony silt loam resemble the Muskingum loam and silt loam but they are very shallow, and stone fragments ranging from several square inches to a foot or more in area and from  $\frac{1}{2}$  to 3 or 4 inches in thickness are scattered over the surface and throughout the soil profile. Stony land, Muskingum soil material, consists of very steep land on which large sandstone masses are scattered, and rock ledges and cliffs on which

little weathered material has accumulated. Where any material has accumulated, it resembles that of the Muskingum soils.

These soils or land types are rapidly to excessively drained. Because of their shallowness and stoniness and the steepness of the slopes on which they occur, they cannot profitably be used for cultivation. A few acres have been used for crops and then abandoned. Over half their area has never been cleared and most of the cleared land is in poor-quality pasture. They have been severely eroded.

Another miscellaneous land type, called mine pits and dumps, includes gravel pits, sand pits, rock quarries, clay pits, and land dug over in mining for coal. No slope or erosion was mapped on this land, and the acreage was not included in the total acreage of soil types in either county. There are 1,877 acres of such land in Muskingum County and 231 acres in Guernsey County.

#### Slopes

Slope classes were designated by the letters A, B, C, and D. A slopes are those with a fall of less than 5 feet in 100 feet (less than 5 percent). On all soils except those in group 4, which contain some limestone, B slopes are from 5 to 20 percent; C slopes, 20 to 30 percent; and D slopes, 30 percent or more. Owing to the greater ease with which hay and pasture grasses may be established and maintained on the soils containing limestone, the limits for the B, C, and D classes were established at a higher level for the soils in group 4. On these soils, B slopes are from 5 to 25 percent; C slopes, from 25 to 40 percent; and D slopes, 40 percent or more.

As previously indicated, each soil group occupies a fairly characteristic range of slope. The distribution of the slope classes in each soil group in Muskingum and Guernsey Counties is shown in table 9. The soils in groups 1, 2, and 4 occur over a wider range of slopes than the soils in the other groups. C and D slopes, however, are dominant on the soils of group 1. Well over half of the total area of the soils in groups 2 and 4 occur on B slopes, but about a third of their area is on C and D slopes. The soils in group 8 occur on the steepest slopes and over half their area is on D slopes. B slopes are dominant on the soils of groups 3 and 5, and there are fairly large acreages on A slopes. The soils in groups 6 and 7 lie almost entirely on A slopes.

Table 9 also brings out the scarcity of level and gently sloping land in either county. Only 15 percent of Muskingum County has a slope of less than 5 percent. Although 47 percent of the county is on B slopes, it must be remembered that the range of this slope class is from 5 to 20 percent for most of the soils and from 5 to 25 percent on the limestone soils. C slopes, ranging from 20 to 30 percent for most soils but from 25 to 40 percent on the limestone soils, make up 20 percent of the county. D slopes, 30 percent or more (40 percent or more on the limestone soils), occupy 18 percent. Almost two-fifths of Muskingum County, therefore, is made up of steep and very steep land.

A slightly larger percentage of Guernsey County is steep or very steep land; D slopes make up 22 percent of the county and C slopes 21 percent. A little more of Guernsey County, 16 percent, lies on A slopes because of the more extensive bottom land along the meanders of Wills Creek. B slopes, however, are less extensive than in Muskingum County, occupying 41 percent of the county. In general, the uplands of Guernsey County are somewhat more dissected than those of Muskingum County and the ridge tops are narrower and more uneven.

TABLE 9.—Distribution of the slope classes in each soil group

MUSKINGUM COUNTY<sup>1</sup>

Soil group	A slopes (less than 5 percent)		B slopes (5-20 percent)		C slopes (20-30 percent)		D slopes (30 percent and over)		Total
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	
1. Shallow soils developed on sandstone and shale or cherty limestone.....	955	0.4	96,202	42.8	63,673	28.2	62,227	27.6	223,057
2. Soils with heavy clay subsoils developed on shale and sandstone.....	66	.7	5,826	26.2	2,619	11.6	1,333	5.8	9,844
3. Deep soils developed on sandstone and shale:									
a. Well-drained, on shale and sandstone.....	14	24.6	13	75.4	0	0	0	0	27
b. Well-drained, on sandstone and shale.....	2,529	6.2	36,899	90.7	1,184	2.8	123	.3	40,635
c. Imperfectly drained.....	485	16.2	2,502	63.8	0	0	0	0	2,987
Total, group 3.....	3,028	6.9	39,405	90.3	1,184	2.6	123	.3	40,739
4. Shallow soils developed on interbedded limestone, sandstone, and shale <sup>2</sup> .....	444	1.0	29,605	61.8	11,401	24.8	5,708	12.4	46,758
5. Soils on terraces:									
a. Well-drained.....	8,420	29.2	18,905	65.7	758	2.6	700	2.6	28,783
b. Imperfectly drained.....	5,949	50.9	4,863	40.3	188	1.8	105	1.0	10,905
Total, group 5.....	13,769	85.0	23,768	60.3	946	2.4	805	2.1	39,721
6. Poorly drained soils on uplands and terraces.....	5,652	93.8	300	0.5	0	0	0	0	5,952
7. Alluvial soils:									
a. Well-drained.....	18,665	96.3	711	3.7	0	0	0	0	19,376
b. Imperfectly drained.....	10,663	98.5	138	1.5	0	0	0	0	10,801
c. Poorly drained.....	7,966	97.9	168	2.1	0	0	0	0	8,134
Total, group 7.....	37,294	97.3	1,017	2.7	0	0	0	0	38,311
8. Miscellaneous soils not suitable for cultivation.....	37	.3	1,787	14.8	2,585	21.4	7,680	63.5	12,089
Entire county <sup>1</sup> .....	61,252	14.6	197,110	46.8	64,468	20.1	77,919	18.6	420,749

GUERNSEY COUNTY<sup>1</sup>

1. Shallow soils developed on sandstone and shale or cherty limestone.....	372	0.3	63,910	45.3	38,511	27.3	38,183	27.1	140,576
2. Soils with heavy clay subsoils developed on shale and sandstone.....	319	2.5	7,402	57.8	3,740	29.2	1,348	10.5	12,809
3. Deep soils developed on sandstone and shale:									
a. Well-drained, on shale and sandstone.....	399	8.8	4,407	91.1	20	.6	0	0	4,826
b. Well-drained, on sandstone and shale.....	963	15.2	5,484	84.8	3	( <sup>4</sup> )	0	0	6,450
c. Imperfectly drained.....	704	57.2	627	42.8	0	0	0	0	1,331
Total, group 3.....	2,066	16.0	10,518	53.1	23	.3	0	0	12,584
4. Shallow soils developed on interbedded limestone, sandstone, and shale <sup>2</sup> .....	185	.8	39,975	74.3	11,204	21.0	2,383	4.4	53,647
5. Soils on terraces:									
a. Well-drained.....	639	14.5	2,745	62.1	690	19.5	171	3.0	4,245
b. Imperfectly drained.....	2,601	32.4	5,447	63.1	311	3.6	77	.9	8,436
Total, group 5.....	3,440	26.3	8,192	62.8	1,001	9.0	248	1.9	12,681
6. Poorly drained soils on uplands and terraces.....	2,370	94.2	145	5.8	0	0	0	0	2,515
7. Alluvial soils:									
a. Well-drained.....	4,058	99.4	25	.6	0	0	0	0	4,083
b. Imperfectly drained.....	26,981	100.0	6	( <sup>4</sup> )	0	0	0	0	27,037
c. Poorly drained.....	11,956	100.0	5	( <sup>4</sup> )	0	0	0	0	11,961
Total, group 7.....	42,995	99.9	36	.1	0	0	0	0	43,031
8. Miscellaneous soils not suitable for cultivation.....	28	.1	7,924	15.2	13,867	26.7	30,156	58.0	51,975
Entire county <sup>1</sup> .....	51,795	15.7	138,002	41.7	68,615	20.7	72,318	21.9	330,730

<sup>1</sup> Does not include 1,877 acres of mine pits, dumps, and quarries and 2,334 acres of water. These miscellaneous areas are not included in tables 9 to 17.

<sup>2</sup> Slope limits on the Belmont, Brooke, and Westmoreland soils are as follows: A, less than 5 percent; B, 5-25 percent; C, 25-40 percent; and D, 40 percent and over.

<sup>3</sup> Does not include 231 acres of mine pits, dumps, and quarries and 559 acres of water. These miscellaneous areas are not included in tables 9 to 17.

<sup>4</sup> Less than 0.1 percent.

Land Use

Four major classes of present land use are shown on the maps. Cropland includes all land plowed and planted to crops, fallow land, orchard, and land seeded down for several years to grass, alfalfa, and other forage crops grown in rotation. Pasture includes all land that is grazed regularly. Woodland includes all areas on which 40 percent or more of the surface is covered by the spread of good forest trees. Idle land consists of areas covered by brush or weeds,

grassland not cut or pastured, and any abandoned areas with little or no cover. A fifth land use class was used for urban areas, farmsteads, golf courses, and mining areas.

As livestock raising is the chief agricultural enterprise, about 40 percent of the land in each county is used for pasture. About 30 percent of each county is in cropland and about half of this is used to grow hay crops. Woodland occupies about 20 percent of each county. Land either temporarily idle or abandoned makes up 8 percent of Muskingum

County and 7 percent of Guernsey County. Land occupied by farmsteads, in towns, or that could not be otherwise classified, makes up a little over 2 percent of Muskingum County and a little less than 2 percent of Guernsey County.

Land use is determined mainly by the character of the soil and by the slope of the land except where erosion has caused abandonment of formerly productive fields. The use of each soil type has been set out in table 17 (pp. 52-61). Table 10 shows the summarized data on land use by soil

groups. Cropland is the dominant use of the terrace and alluvial soils (groups 5a, 5b, and 7a) and the deeper upland soils (groups 3a and 3b). The poorly drained upland and terrace soils (group 6) have been used for crops where drained or in conjunction with other better drained lands. Otherwise, they are used for pasture. The shallow upland soils (groups 1, 2, and 4) are used largely for pasture. The largest acreages of cropland, however, are on the soils of groups 1 and 4, since they are the most extensive. Pasture is also the dominant land

TABLE 10.--Distribution of the land use classes in each soil group  
MUSKINGUM COUNTY

Soil group	Cropland		Idle land		Pasture		Woodland		Farmyards and urban areas		Total
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	
1. Shallow soils developed on sandstone and shale or cherty limestone	52,377	23.8	19,911	8.8	35,280	37.9	64,054	28.5	3,438	1.5	225,060
2. Soils with heavy clay subsoils developed on shale and sandstone	2,404	24.4	982	10.0	5,009	50.8	1,367	13.9	86	.9	9,848
3. Deep soils developed on sandstone and shale:											
a. Well-drained, on shale and sandstone	21	36.8	14	24.6	7	12.3	15	26.3	0		57
b. Well-drained, on sandstone and shale	18,744	45.2	4,112	10.1	14,533	35.7	2,086	5.1	1,100	2.9	40,655
c. Imperfectly drained	1,140	38.2	218	7.3	1,500	50.2	112	3.7	17	.6	2,987
Total, group 3	10,905	45.5	4,344	9.9	16,040	36.7	2,213	5.1	1,207	2.8	43,709
4. Shallow soils developed on interbedded limestone, sandstone, and shale	12,904	27.8	1,625	3.5	20,225	56.6	5,065	10.9	579	1.2	46,398
5. Soils on terraces:											
a. Well-drained	14,390	49.9	2,473	8.6	7,079	24.6	1,801	4.5	3,576	12.4	28,789
b. Imperfectly drained	6,917	36.3	602	5.7	3,116	20.7	291	2.8	577	5.5	10,505
Total, group 5	20,277	51.6	3,075	7.8	10,197	28.0	1,592	4.0	4,153	10.6	39,294
6. Poorly drained soils on uplands and terraces	2,850	47.2	354	5.8	2,299	38.1	396	6.5	143	2.4	6,042
7. Alluvial soils:											
a. Well-drained	11,373	53.7	1,206	6.2	3,927	20.3	1,934	10.2	888	4.6	19,376
b. Imperfectly drained	4,499	41.6	599	5.5	4,401	40.7	1,123	10.4	201	1.8	10,823
c. Poorly drained	1,858	22.8	738	9.1	4,486	55.3	919	11.8	121	1.5	6,134
Total, group 7	17,730	48.3	2,543	6.6	12,826	33.5	4,026	10.5	1,208	3.1	38,333
8. Miscellaneous soils not suitable for cultivation	1,231	10.1	404	3.8	4,630	38.4	5,670	47.0	80	.7	12,005
Entire county	129,668	30.8	33,298	7.9	162,506	38.6	84,883	20.1	10,594	2.6	420,749

GUERNSEY COUNTY

1. Shallow soils developed on sandstone and shale or cherty limestone	37,289	26.4	11,208	8.0	58,775	41.7	31,155	22.1	2,491	1.8	140,978
2. Soils with heavy clay subsoils developed on shale and sandstone	3,865	26.3	1,370	10.6	5,807	45.3	2,162	16.9	112	.9	12,809
3. Deep soils developed on sandstone and shale:											
a. Well-drained, on shale and sandstone	2,941	60.5	501	10.4	1,186	24.5	167	3.5	40	.8	4,835
b. Well-drained, on sandstone and shale	3,591	55.5	492	7.6	1,818	28.1	328	5.1	241	3.7	6,470
c. Imperfectly drained	825	67.0	59	4.8	303	24.6	17	1.4	27	2.2	1,231
Total, group 3	7,357	55.6	1,052	6.4	3,307	20.4	512	4.1	308	2.5	12,536
4. Shallow soils developed on interbedded bedded limestone, sandstone, and shale	16,065	29.9	3,027	5.0	26,697	49.4	7,539	14.0	888	1.1	53,836
5. Soils on terraces:											
a. Well-drained	2,260	51.2	240	5.4	1,467	33.2	745	3.3	203	6.9	4,415
b. Imperfectly drained	4,646	63.8	387	4.5	2,631	30.5	159	1.8	813	9.4	8,636
Total, group 5	6,906	62.9	627	4.8	4,098	31.4	304	2.3	1,116	8.6	13,051
6. Poorly drained soils on uplands and terraces	1,127	44.8	83	3.3	653	26.0	32	1.8	620	24.6	2,515
7. Alluvial soils:											
a. Well-drained	2,050	50.2	181	4.4	1,473	36.1	332	8.1	47	1.2	4,083
b. Imperfectly drained	13,171	48.6	1,125	4.2	10,640	39.4	1,091	6.8	360	1.3	26,987
c. Poorly drained	3,321	27.8	1,717	14.4	5,721	47.8	1,115	9.3	87	.7	11,961
Total, group 7	18,542	48.1	3,023	7.0	17,834	41.5	3,138	7.3	494	1.1	43,031
8. Miscellaneous soils not suitable for cultivation	5,938	11.5	2,500	5.0	17,798	34.2	25,477	49.0	151	.3	51,974
Entire county	96,632	20.2	28,030	6.9	134,869	40.8	70,319	21.3	5,880	1.8	330,730

TABLE 11.—Distribution of the land use classes in each slope class<sup>1</sup>

MUSKINGUM COUNTY

Land use class	A slopes (less than 5 percent)		B slopes (5-20 percent)		C slopes (20-30 percent)		D slopes (30 percent or more)		Entire county	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Cropland.....	30,681	50.1	78,695	39.9	16,536	18.4	4,750	6.1	129,662	30.8
Idle land.....	4,224	6.9	17,496	8.9	7,683	9.0	4,025	5.2	33,428	7.2
Pasture.....	13,545	30.3	78,720	39.9	41,673	48.1	24,664	31.5	162,562	38.6
Woodland.....	4,691	7.6	13,890	8.1	20,094	23.8	43,708	56.1	82,383	20.1
Farmyards and urban areas.....	3,111	5.1	6,359	3.2	582	.7	892	1.1	10,944	2.6
Total.....	61,252	100.0	197,110	100.0	84,468	100.0	77,919	100.0	420,749	100.0

GUERNSEY COUNTY

Cropland.....	23,317	45.0	59,099	40.7	13,056	19.0	4,160	5.7	96,632	29.9
Idle land.....	3,485	6.7	11,189	8.1	5,048	7.4	3,306	4.6	23,038	6.0
Pasture.....	20,043	38.7	50,040	40.6	35,142	51.2	23,644	32.7	134,869	40.8
Woodland.....	3,341	6.5	11,056	8.0	14,805	21.6	41,117	56.9	70,319	21.7
Farmyards and urban areas.....	1,609	3.1	3,614	2.6	568	.8	80	.1	6,061	1.8
Total.....	51,795	100.0	137,998	100.0	68,619	100.0	72,318	100.0	330,730	100.0

<sup>1</sup> Slope limits on the Belmont, Brooke, and Westmoreland soils are as follows: A, less than 5 percent; B, 5-25 percent; C, 25-40 percent; D, 40 percent and over.

use on the soils in groups 3c and 7c. The imperfectly drained alluvial soils in group 7b are used about equally for cropland and pasture. Woodland is dominant on the stony soils in group 8.

Table 11, which gives the distribution of the various land use classes in each slope class, shows that there is serious misuse of large acreages of C and D slopes. Although most of the cropland is on A and B slopes, C slopes are now cultivated to the extent of 15,536 acres in Muskingum County and 13,056 acres in Guernsey County. D slopes are cultivated to the extent of 4,756 acres in Muskingum County and 4,160 acres in Guernsey County. These acreages constitute about one-sixth of the cropland in each county.

Pasture is distributed mainly on the B and C slopes, but there are also large acreages of pasture on A and D slopes. Over half the woodland is on D slopes.

Erosion

Erosion is designated on the maps by the following symbols:

Sheet erosion:

2. Less than 25 percent of topsoil removed.
3. 25 to 75 percent of topsoil removed.
4. 75 percent or more of topsoil removed or all topsoil and part of subsoil removed.
5. Part or all of subsoil removed, parent material may be eroded.

Gully erosion:

7. Occasional gullies: More than 100 feet apart.
8. Frequent gullies: Occurring less than 100 feet apart but including less than 75 percent of the area delineated.
9. Very frequent or large gullies.
- . Indicates gullies too deep to be crossed with tillage implements, as ⑦ or ⑧.
- V. Indicates gullies too deep to be crossed with tillage implements that have penetrated into a friable parent material, as 7V or 8V.

Miscellaneous:

1. No apparent erosion.
6. Slips, or landslides, that have dropped less than 3 feet.
- 6V. Slips, or landslides, that have dropped 3 feet or more.

Sheet, gully, and slip erosion were mapped in the two counties. Sheet erosion is the removal of a more or less uniform layer of soil by running water. It may be accompanied by the formation of small rills or channels that are ordinarily smoothed out by cultivation. When these channels become too deep to be cultivated out they are known as gullies. Gully erosion is shown in conjunction with sheet erosion on the maps. The frequency and depth of gullies and the degree of sheet erosion are shown.

Slips or landslides are masses of soil that have moved downhill as a unit. These mass movements are commonly followed by gullying, and where this has occurred both gully and slip erosion are shown on the maps. Most of these areas have also been sheet-eroded either before or after slipping, but the mass movement overshadows this effect in the future use of the land. Thus no sheet erosion is shown with slip erosion on the maps.

Thirty-five different classes of erosion were mapped in the survey. These classes and the manner in which they are grouped to indicate severity of erosion are shown in table 12.

No apparent erosion was mapped on about an eighth of each county. A large part of the acreage included in this erosion group is on the alluvial soils of the first bottoms, which receive deposits of sediments carried by the streams. Most of the deposits have been beneficial rather than harmful, but in recent years stone fragments and subsoil material have been brought down in sufficient quantities to be detrimental in a few areas. They are part of a vast amount of material that has been washed from the surrounding hills.

The remaining land in the two counties has been eroded to some degree. Slight erosion, which is the loss of less than 25 percent of the topsoil accompanied on a few acres by occasional gullies, has affected 19 percent of Muskingum County and 5 percent of Guernsey County. These are still good lands, but they need to be protected by conservation farming from further loss of soil.

Lands moderately damaged by erosion, 25 to 75 percent of the topsoil lost together with some gullying, make up about half of each county. Although most of these areas may still be cultivated, they are critical areas in which the most careful and complete erosion-control measures should be used. This is particularly true for the shallow soils in which the

loss of half the topsoil brings the rocky underlying material very close to the surface of the ground.

Guernsey County is more severely eroded than Muskingum County. About one-third of Guernsey County and about one-sixth of Muskingum County are severely or very severely eroded. These lands have lost at least 75 percent of the topsoil and usually some subsoil and are no longer suitable for cultivation. They should be placed under a protective grass or tree cover to prevent more extreme damage. These lands are also those most severely damaged by gullies that will cut into adjacent better lands unless controlled.

Numerous gullies have been cut in the land in both counties, although they are somewhat more frequent in Muskingum than in Guernsey County. About 24 percent of Muskingum County and 17 percent of Guernsey County has been gullied to some extent in addition to being damaged by sheet or slip erosion.

Landslides are conspicuous on many hillsides in this part of Ohio, particularly in southeastern Muskingum and southern Guernsey Counties where the underlying rock is mostly shale. The total area in Muskingum County affected by landslides or slips

is 6,274 acres, or 1.5 percent of the county. In Guernsey County similar slides have affected 10,757 acres, or 3.3 percent of the county. The soils in which these mass movements occur are usually marked by a rather high clay content, and the underlying material is tight and slowly pervious to water. Water accumulates, saturating the lower part of the soil, which then flows downhill, forcing the sod lower down into a bulge. Farther up the hill the tension thus produced causes the surface soil to crack and slump down onto the new level. These areas are particularly susceptible to further cracking and to gullying. Unstable areas such as these are of particular interest to engineers in constructing highways and railway fills.

These landslides or slips are very common on the soils of groups 2 and 4, which have clay subsoils and are underlain mainly by shales. They are present to some extent on the more shaly areas of Muskingum silt loam in group 1, where the underlying material is dominantly shale and the subsoil has a higher clay content than is typical of the Muskingum soils. They generally occur when the land is in pasture or hay. Under a grass cover more water percolates into the soil and, if its downward movement is retarded by an impervious layer of rock or soil, completely saturates the soil. Some slipping has occurred in open woodlands that have much grass sod between the trees and, in some places, has moved trees downhill along with large blocks of earth and soil.

TABLE 12.—Acreage and percentage of each erosion group and class

Erosion group and class	Muskingum County		Guernsey County	
	Acres	Percent	Acres	Percent
No apparent erosion:	49,151	11.8	43,479	13.1
Slight erosion:				
2	79,188	18.8	15,737	4.8
2 <sup>1</sup>	610	.1	26	( <sup>1</sup> )
2 <sup>2</sup>	66	( <sup>1</sup> )	6	( <sup>1</sup> )
2 <sup>3</sup>	18	( <sup>1</sup> )	0	
Total	79,882	18.9	15,769	4.8
Moderate erosion:				
2 <sup>4</sup>	102	( <sup>1</sup> )	0	
2 <sup>5</sup>	107	( <sup>1</sup> )	0	
3	171,569	40.8	134,556	40.7
3 <sup>1</sup>	35,492	8.6	18,734	5.7
3 <sup>2</sup>	7,444	1.7	3,609	1.1
3 <sup>3</sup>	238	.1	15	( <sup>1</sup> )
3 <sup>4</sup>	2,006	.5	2,500	.8
3 <sup>5</sup>	703	.2	249	.1
Total	218,250	51.9	159,663	48.4
Severe erosion:				
3 <sup>6</sup>	2,757	.7	894	.1
4	42,673	10.2	77,198	23.3
4 <sup>1</sup>	9,961	2.4	15,515	4.7
4 <sup>2</sup>	3,035	.7	4,036	1.2
4 <sup>3</sup>	19	( <sup>1</sup> )	29	( <sup>1</sup> )
4 <sup>4</sup>	1,291	.3	5,737	1.7
4 <sup>5</sup>	997	.2	1,577	.5
4 <sup>6</sup>	10	( <sup>1</sup> )	0	
Total	60,963	14.5	104,486	31.5
Very severe erosion:				
3 <sup>6</sup>	2,709	.7	170	.1
3 <sup>6</sup>	47	( <sup>1</sup> )	8	( <sup>1</sup> )
4 <sup>6</sup>	1,745	.4	2,179	.7
4 <sup>6</sup>	3,157	.8	2,088	.6
4 <sup>6</sup>	47	( <sup>1</sup> )	0	
5	1,309	.3	959	.3
5 <sup>1</sup>	64	( <sup>1</sup> )	315	.1
5 <sup>2</sup>	16	( <sup>1</sup> )	63	( <sup>1</sup> )
5 <sup>3</sup>	223	.1	100	( <sup>1</sup> )
5 <sup>4</sup>	113	( <sup>1</sup> )	157	( <sup>1</sup> )
5 <sup>5</sup>	0		9	( <sup>1</sup> )
5 <sup>6</sup>	375	.1	496	.1
6 <sup>1</sup>	893	.2	198	.1
6 <sup>2</sup>	1,485	.3	501	.1
Total	12,173	2.9	7,333	2.2
Grand total	420,749	100.0	330,730	100.0

<sup>1</sup> Less than 0.1 percent.

### Relation of Erosion to Other Factors

The frequency of intense rains and the time of year in which they occur have special significance with respect to water erosion. Most of the intense rains occur during the spring and summer seasons (p. 34), when land is being plowed and cultivated for corn and pastures are likely to be overgrazed and burned out.

The relation of erosion to the different soil groups is shown in table 13. Erosion has been most severe on the shallow upland soils (groups 1, 2, and 4) and on the stony soils (group 8). These soils also occupy the steepest slopes in the two counties. More than 20 percent of the total area of the soils in groups 1 and 2 has been severely or very severely eroded and most of the remainder has been at least moderately eroded. This is despite the fact that the soils are chiefly in pasture. Poor pasture stands, however, are the rule rather than the exception on these soils and protective cover is poor. The soils in group 4 show a larger percentage of moderate erosion and somewhat smaller percentages of severe and very severe erosion. Pasture stands are generally much better on these soils than on the soils in groups 1 and 2. The shallow stony soils are the most severely eroded of all the soils, largely because of very steep slopes and scarcity of any protective cover.

Moderate and slight erosion are dominant on the soils in groups 3 and 5, although some areas have been more severely eroded. Slight erosion is dominant on the soils in group 6, which are mainly on A slopes. The alluvial soils (group 7) for the most part have not been eroded but are subject to deposition.

Increase in slope generally brings about increased runoff and increased velocity of runoff, both of which cause increased erosion. The relationship of slope to erosion in Muskingum and Guernsey Counties is shown in table 14.

No apparent erosion, which includes recent deposits, is dominant on the A slopes. Only a very small part of their area has been more than slightly

TABLE 13.—Distribution of the erosion groups in each soil group

MUSKINGUM COUNTY

Soil group	No apparent erosion		Slight erosion		Moderate erosion		Severe erosion		Very severe erosion		Total
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	
1. Shallow soils developed on sandstone and shale or cherty limestone	8,441	1.5	23,442	11.3	137,094	61.2	49,798	22.1	8,359	3.7	254,000
2. Soils with heavy clay subsoils developed on shale and sandstone	73	.7	969	3.9	6,834	69.3	1,218	12.3	537	3.7	9,831
3. Deep soils developed on sandstone and shale:											
a. Well-drained, on shale and sandstone	0		16	28.1	41	71.9	0		0		57
b. Well-drained, on sandstone and shale	4,152	10.2	18,316	45.0	17,563	43.2	816	1.3	128	.3	60,985
c. Imperfectly drained	438	14.7	1,323	44.3	926	32.0	263	8.3	7	.2	3,657
Total, group 3	4,590	10.5	19,655	48.0	18,530	42.4	779	1.8	135	.3	43,700
4. Shallow soils developed on interbedded limestone, sandstone, and shale	422	.9	4,822	9.7	34,594	74.6	4,251	9.2	2,049	8.6	40,098
5. Soils on terraces:											
a. Well-drained	1,455	5.1	16,052	57.8	10,231	35.5	333	1.2	118	.4	28,189
b. Imperfectly drained	1,187	11.3	6,892	65.5	2,225	21.2	175	1.7	43	.3	10,524
Total, group 5	2,642	6.7	22,944	59.9	12,456	31.7	511	1.3	161	.4	38,704
6. Poorly drained soils on uplands and terraces	1,771	29.3	4,092	67.8	117	1.9	57	.9	8	.1	6,045
7. Alluvial soils:											
a. Well-drained	17,862	92.2	1,261	6.5	253	1.3	0		0		19,376
b. Imperfectly drained	10,630	98.2	176	1.6	17	.2	0		0		10,823
c. Poorly drained	7,946	97.7	151	1.8	31	.4	0		0		8,128
Total, group 7	36,438	95.1	1,588	4.1	301	.8	0		0	(1)	38,327
8. Miscellaneous soils not suitable for cultivation	74	.6	180	1.5	7,404	61.4	4,387	36.3	20	.2	12,065
Entire county	49,451	11.8	79,862	18.9	218,250	51.9	60,938	14.6	12,173	2.9	420,740

GUERNSEY COUNTY

1. Shallow soils developed on sandstone and shale or cherty limestone	147	0.1	3,196	2.3	76,165	64.0	58,903	41.8	2,867	1.8	140,173
2. Soils with heavy clay subsoils developed on shale and sandstone	14	.1	300	2.3	7,484	68.4	4,003	31.7	1,006	7.9	12,897
3. Deep soils developed on sandstone and shale:											
a. Well-drained, on shale and sandstone	20	.4	883	18.3	3,331	68.9	491	10.2	110	2.2	4,835
b. Well-drained, on sandstone and shale	6	.1	1,709	26.4	4,691	72.1	74	1.1	20	.3	6,470
c. Imperfectly drained	17	1.4	799	64.9	413	33.5	2	.2	0		2,921
Total, group 3	43	.3	3,391	27.1	8,435	67.1	567	4.5	130	1.0	12,536
4. Shallow soils developed on interbedded limestone, sandstone, and shale	6	(1)	749	1.4	39,627	73.6	10,792	19.9	2,782	6.1	53,956
5. Soils on terraces:											
a. Well-drained	13	.3	1,167	26.4	2,262	51.3	946	21.4	27	.6	4,415
b. Imperfectly drained	191	2.2	3,854	44.6	4,125	47.8	435	5.0	31	.4	8,606
Total, group 5	204	1.6	5,021	38.5	6,387	48.9	1,381	10.6	58	.4	13,021
6. Poorly drained soils on uplands and terraces	200	8.0	2,225	58.5	89	3.5	1	(1)	0		2,515
7. Alluvial soils:											
a. Well-drained	4,049	99.2	21	.5	13	.3	0		0		4,083
b. Imperfectly drained	26,843	99.5	144	.5	0	0	0		0		27,027
c. Poorly drained	11,949	99.9	7	.1	5	(1)	0		0		11,961
Total, group 7	42,841	99.6	172	.4	18	(1)	0		0		44,841
8. Miscellaneous soils not suitable for cultivation	24	(1)	715	1.4	21,488	41.3	28,929	55.7	918	1.6	51,974
Entire county	43,479	13.1	15,769	4.8	159,663	48.4	104,486	31.6	7,333	2.2	284,730

(1) Less than 0.1 percent.

eroded. Moderate erosion is dominant on the B slopes, which together with the A slopes are used most extensively for cultivated crops, but there are also large acreages of these slopes that have been more severely eroded. C and D slopes are the most severely eroded despite the fact that less of their area is now in cultivation. The sparseness of pasture stands and the grazing of woodlands, which is common in these counties, account for much of the erosion on these steeper slopes. Another factor contributing to erosion on C and D slopes is that many of them were formerly cultivated and then allowed to revert to pasture or woodland.

The relation of erosion to land use is shown in table 15. A greater acreage of severe and very

severe erosion was mapped on idle land than on any other land use class. Much of the land now idle, however, was formerly used for cropland or pasture and then abandoned because of extreme erosion. The severity of erosion on pastures is due to several causes, some of which are former cultivation and conversion of land to pasture only when it becomes unproductive, lack of pasture treatment, and overgrazing. Woodland shows less severe and very severe erosion than either pasture or idle land. Most of the erosion that has occurred in woodlands is due to trampling and grazing of livestock. Over half the present cropland in Muskingum County and almost three-fourths of that in Guernsey County has been moderately or more severely eroded.

TABLE 14.—Distribution of the erosion groups in each slope class

Erosion group	MUSKINGUM COUNTY									
	A slopes (less than 5 percent)		B slopes (5-20 percent)		C slopes (20-30 percent)		D slopes (30 percent or more)		Entire county	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
No apparent erosion.....	40,985	66.9	4,802	2.5	1,563	1.0	2,041	2.6	49,451	11.8
Slight erosion.....	18,510	31.9	45,167	22.0	7,305	8.0	7,900	10.1	79,882	18.9
Moderate erosion.....	686	1.1	130,359	66.1	52,235	61.8	34,970	44.9	218,250	51.0
Severe erosion.....	67	.1	12,746	6.5	19,061	22.6	29,119	37.4	60,993	14.6
Very severe erosion.....	4	(?)	3,978	2.0	4,304	5.1	3,889	5.0	12,173	2.9
Total.....	61,252	100.0	197,110	100.0	84,468	100.0	77,919	100.0	420,749	100.0

Erosion group	GUERNSEY COUNTY									
	A slopes (less than 5 percent)		B slopes (5-20 percent)		C slopes (20-30 percent)		D slopes (30 percent or more)		Entire county	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
No apparent erosion.....	43,256	83.6	178	0.1	32	(?)	13	(?)	43,479	13.1
Slight erosion.....	6,438	12.4	7,776	5.7	854	1.2	701	1.0	15,769	4.8
Moderate erosion.....	2,063	4.0	100,573	72.9	25,413	37.1	31,584	43.7	159,663	48.4
Severe erosion.....	8	(?)	27,077	19.6	38,692	56.4	38,709	53.6	104,486	31.5
Very severe erosion.....	0		2,394	1.7	3,028	5.3	1,311	1.8	7,333	2.2
Total.....	51,795	100.0	137,998	100.0	68,619	100.0	72,318	100.0	330,730	100.0

<sup>1</sup> Slope limits on the Belmont, Brooke, and Westmoreland soils are as follows: A, less than 5 percent; B, 5-25 percent; C, 25-40 percent; D, 40 percent and over.  
<sup>2</sup> Less than 0.1 percent.

TABLE 15.—Distribution of the erosion groups in each land use class

Erosion group	MUSKINGUM COUNTY											
	Cropland		Idle land		Pasture		Woodland		Farmyards and urban areas		Entire county	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
No apparent erosion.....	19,590	15.1	3,454	10.4	17,910	11.0	7,492	8.9	1,005	9.2	49,451	11.8
Slight erosion.....	30,080	23.2	5,305	15.9	18,665	11.5	20,166	23.9	5,660	52.0	79,882	18.9
Moderate erosion.....	68,247	52.7	16,804	50.5	89,014	55.3	39,548	46.8	3,742	34.3	218,250	51.9
Severe erosion.....	10,538	8.1	5,632	16.9	28,694	17.7	15,670	18.0	458	4.2	60,993	14.6
Very severe erosion.....	1,212	.9	2,103	6.3	7,323	4.5	1,506	1.8	29	.3	12,173	2.9
Total.....	129,668	100.0	33,298	100.0	162,506	100.0	84,383	100.0	10,894	100.0	420,749	100.0

Erosion group	GUERNSEY COUNTY											
	Cropland		Idle land		Pasture		Woodland		Farmyards and urban areas		Entire county	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
No apparent erosion.....	18,826	19.5	3,035	13.2	18,025	13.3	3,214	4.6	379	6.4	43,479	13.1
Slight erosion.....	7,145	7.4	530	2.3	3,058	2.3	2,315	3.3	2,691	45.8	15,769	4.8
Moderate erosion.....	48,242	49.9	8,360	36.3	57,950	43.0	43,004	61.1	2,107	36.8	159,663	48.4
Severe erosion.....	21,373	22.1	9,848	42.8	51,207	38.0	21,378	30.4	680	11.6	104,486	31.5
Very severe erosion.....	1,046	1.1	1,257	5.4	4,599	3.4	408	.6	23	.4	7,333	2.2
Total.....	96,632	100.0	23,030	100.0	134,899	100.0	70,319	100.0	5,880	100.0	330,730	100.0

### Summary

The soil conservation survey shows that 53 percent of Muskingum County, Ohio, and 42 percent of Guernsey County are suitable for cultivation. But special conservation practices must be used on most of this cultivable land if it is to be safely kept in cultivation. Only 5 percent of Muskingum County and 1.3 percent of Guernsey County is class I land, which can be cultivated without special practices. Class II land, on which one or more simple special erosion-control or drainage measures are needed, makes up 14 percent of Muskingum County and 11 percent of Guernsey County. Class III land, on which careful and intensive erosion-control practices are necessary to maintain it in cultivation, amounts to 34 percent of Muskingum County and 30 percent of

Guernsey County. Another 9 percent of Muskingum County and 11 percent of Guernsey County is class IV land, which should be used primarily for long-term hay or permanent pasture but on which a crop may be grown occasionally if needed or to reestablish a hay stand.

The rest of the land in the two counties is not suitable for cultivation. Some, amounting to 13 percent of Muskingum County and 10 percent of Guernsey County, is class VI land which may be used for permanent pastures, but the class VII land, making up 25 percent of Muskingum County and 37 percent of Guernsey County, should be in woodland. Class VIII land, consisting of strip-mining areas, quarries, and sand pits, is not suitable for any vegetation that is to be harvested but has possibilities for development as wildlife and recreational areas.

The survey also brings out that 17 percent of all the land in Muskingum County and 34 percent of that in Guernsey County has already been severely or very severely eroded. About half of each county has been moderately eroded. To prevent further soil loss and to keep up production, conservation farming methods suited to the needs of the land must be immediately applied.

The farming practices recommended for the class II and III croplands in these two southeastern Ohio counties include applications of lime, manure, and fertilizer where needed, rotation of crops, green manuring, drainage of some of the land, contour cultivation, strip cropping, terracing, diversions, grassed waterways, and gully control. Practices for pasture management on all classes of land include applications of lime, fertilizer, and manure, mowing, grazing control, re-seeding if necessary, and gully control. Good woodland management calls for exclusion of livestock, protection from fire, selective cutting of mature trees, and the removal of grapevines, weed trees, and dead and other undesirable trees. Wildlife can be encour-

aged on many areas in conjunction with other farming practices.

At the present time some adjustments are necessary to bring land use into harmony with physical land capability. A fourth of the land now used regularly for crops in Muskingum County, and a third of that in Guernsey County is in classes IV, VI, and VII, and should be taken out of regular cultivation and put into permanent pasture or reforested. It is either too steep and eroded or too poorly drained to be safely and profitably cultivated. The same proportions of the present pastures are in class VII and should be reforested. There is available in both counties enough land suitable for cropland or pasture to replace all this unsuitable land. But not all the farmers, particularly in the southern sections, have enough suitable land on their own farms, to make such adjustments and keep up their present crop acreages. If the best use is to be made of the land and maximum long-time production obtained, however, the land must ~~be used within the limits of its physical~~ capability.



TABLE 16.—Characteristics of soils in

Soil group and series	Soil types mapped	Soil profile				
		Surface soil	Subsoil	Lower subsoil		
1. Shallow soils developed on sandstone and shale or cherty limestone: Frankstown.....	Cherty silt loam.....	Grayish-brown silt loam 6 to 8 inches thick. Numerous chert fragments.	Pale-yellow to yellowish-brown very cherty heavy silt loam about 10 inches thick.	Yellow to brownish-yellow silty clay loam about 10 inches thick.		
	Loam.....	Dark-gray to grayish-brown loam 8 to 10 inches thick.	Yellowish-brown slightly compact loam about 4 to 6 inches thick.			
	Silt loam.....	Brown to grayish-brown friable silt loam 8 to 10 inches thick.	Dull-brown to yellowish-brown smooth silt loam about 3 inches thick.	Brown to yellowish-brown slightly compact silt loam. Occasional sandstone and shale fragments. 8 to 10 inches thick.		
	Muskingum.....	Silt loam, colluvial phase.....	do.....	Dull-brown to yellowish-brown smooth silt loam about 10 inches thick.	Brown to yellowish-brown slightly compact silt loam. Occasional sandstone and shale fragments.	
2. Soils with heavy clay subsoils developed on shale and sandstone: Effort.....	Silt loam.....	Grayish-brown silt loam 6 inches thick.	Yellowish-brown heavy silt loam about 5 or 6 inches thick.	Gray clay below 10 to 12 inches.		
	Mefes (Muskingum-Upshur).....	Silty clay loam.....	Variable in texture and color. 6 to 8 inches thick. A soil complex of areas of yellowish-brown Muskingum silt loam and red Upshur clay.	Variable in color and texture. Soil complex of yellowish-brown silt loam and red clay.		
Rarden.....	Silt loam.....	Brown to grayish-brown silt loam 6 to 8 inches thick.	Variiegated red, yellow, and gray silty clay loam 10 inches thick.	Gray silty clay loam below 18 to 20 inches.		
Upshur.....	Clay.....	Reddish-brown silty clay loam to clay 6 to 10 inches thick.	Heavy brownish-red to red silty clay loam to clay 8 to 10 inches thick.	Very heavy red clay 20 inches or more thick.		
3. Deep soils developed on sandstone and shale: a. Well-drained, on shale and sandstone:	Coolville.....	Silt loam.....	Brown to grayish-brown silt loam 6 to 8 inches thick.	Bright yellowish-brown heavy silt loam grading into variegated red, yellow, and yellowish-brown heavy silt loam or silty clay loam mottled with gray. About 10 to 12 inches thick.	Reddish-brown or variegated reddish-brown and gray heavy silty clay about 20 to 30 inches thick.	
	Guernsey.....	Silt loam.....	Grayish-brown to yellowish-brown silt loam 8 to 10 inches thick.	Yellow to brownish-yellow slightly compact silt loam, about 10 inches thick; below 18 inches, brownish-yellow silty clay loam mottled with gray.	Olive-yellow heavy blocky clay with slight greenish-gray tinge. About 12 to 14 inches thick.	
	Keene.....	Silt loam.....	Brown to grayish-brown silt loam 6 to 8 inches thick.	Yellow to grayish-yellow slightly heavy silt loam about 14 inches thick. Slight-gray mottling at depths of 20 inches.	Light-gray clay mottled with yellow. Mixed with partly weathered shale.	
	b. Well-drained, on sandstone and shale: Hanover.....	Silt loam.....	do.....	Yellowish-brown moderately heavy silt loam about 30 inches thick.	Pale yellowish-brown gravelly loam containing numerous rounded and sub-angular fragments. Weathered sandstone and shale material.	
		Wellston.....	Silt loam.....	Grayish-brown silt loam 10 to 12 inches thick.	Brownish-yellow slightly heavy silt loam about 24 inches thick.	
		Zanesville.....	Silt loam.....	Brown silt loam 10 inches thick.	Light-brown or brownish-yellow very slightly compact silt loam about 8 inches thick.	Brownish-yellow silt loam free from sandstone and shale fragments to a depth of 40 inches or more.
	c. Imperfectly drained: Tusitt.....	Silt loam.....	Gray to brownish-gray silt loam 8 inches thick.	Yellowish-brown slightly compact silt loam about 8 to 12 inches thick.	Mottled gray and yellow compact heavy silt loam to silty clay loam.	

	Natural drainage		Distribution in Muskingum and Guernsey Counties	Remarks
	Surface	Internal		
Cherty limestone below 30 to 40 inches.	Good	Good	Rolling ridges along Flint Ridge and spurs extending from it in western Muskingum County.	Neutral to slightly acid. Early soil in spring, owing to large amounts of chert. Variations: Surface soil of some areas less cherty, depth to parent material greater in some areas; other areas imperfectly drained with mottled subsoil.
Below 12 to 24 inches partly disintegrated sandstone, often a mass of loose fragments.	Excessive	do	Steep, bumpy, and irregular ridges and knolls throughout the counties.	Acid throughout.
Partly disintegrated sandstone and shale below 20 to 30 inches.	Good	do	Extensive throughout counties.	Do.
Partly disintegrated sandstone and shale mixed with some soil material.	do	do	In small scattered depressions and at base of slopes.	Acid throughout. Much deeper than Muskingum loam and silt loam.
Fire clay and clay shales 20 to 30 inches below surface.	do	Fair	On hillsides and at bottom of slopes in small narrow strips in eastern Muskingum County and western Guernsey.	Strongly acid.
Shale, clay shale, and sandstone below 24 to 36 inches.	do	Good	Ridges and upper slopes in southern and southeastern Muskingum County and southern Guernsey.	Moderately acid. Subject to severe sheet and gully erosion. Slips and landslides common. Extremely variable.
Shale and sandstone below 30 to 36 inches.	do	Fair to good	Small scattered gently rolling upland areas mainly in eastern Muskingum County and western Guernsey.	Strongly acid
Clay shales below 30 to 40 inches.	do	Good	Small scattered areas in southeastern Muskingum County and southern Guernsey.	Moderately acid to slightly acid. Texture of surface variable because of severe erosion.
Red shale below 40 to 50 inches.	do	Fair	Small scattered flat to undulating areas over east- and west-central Guernsey County, mainly around Claysville.	Strongly acid.
Weathered calcareous shale and sandstone intermixed with limestone below 40 to 50 inches.	do	do	Broad flat to undulating ridges in north-central part of Guernsey County.	Surface soil acid, subsoil slightly alkaline
Noncalcareous shale and sandstone below 36 inches.	do	do	Undulating to gently rolling areas in Guernsey County a few miles east of New Concord.	Acid.
Glacial drift (sandstone and shale) below 40 to 50 inches.	do	Good	Only in the western part of Muskingum County chiefly south of Gratot in Hopewell Township.	Strongly acid.
Sandstone and shale below 46 to 40 inches.	do	do	On scattered nearly flat to undulating broad ridges.	Do.
Silt-loam material resting on sandstone and shale below 40 to 60 inches.	do	do	Broad nearly flat ridges mainly east and north of Zanesville in Muskingum County.	Do.
Sandstone and shale below 36 to 48 inches.	Fair to good	Fair	Broad flat ridge top throughout the two counties.	Do.

TABLE 16. Cha

Soil group and series	Soil types mapped	Soil profile	
		Surface soil	Subsoil
4. Shallow soils developed on interbedded limestone, sandstone, and shale: Belmont.....	Silty clay loam.....	A soil complex of Brooke, Muskingum, and Upshur.	Soil complex, usually red owing to dominance of red shale.
Brooke.....	Silt loam.....	Dark-brown heavy granular silty clay loam 6 inches thick.	Olive-yellow blocky clay about 18 inches thick.
Westmoreland.....	Silt loam..... Silty clay loam, colluvial phase.	Variable in color and texture. Soil complex including areas of Muskingum and Brooke. Brown to grayish brown.	Variable. Dominantly yellowish brown. Texture ranges from silt loam to silty clay loam.
5. Soils on terraces: a. Well-drained: Chenango.....	Gravelly loam..... Loam. Sandy loam. Silt loam, deep phase.	Brown; mellow; soft crumb structure; 8 to 12 inches thick.	Yellowish-brown friable loam to clay loam about 10 inches thick.
Elk.....	Silt loam.....	Brown silt loam; 8 to 12 inches thick.	Yellowish-brown slightly compact silt loam about 6 to 8 inches thick.
Holston.....	Loam..... Loam, high terrace phase. Sandy loam. Silt loam. Silt loam, high terrace phase.	Brown to yellowish brown; 8 to 12 inches thick.	Yellowish-brown moderately heavy silt loam.
Vincent.....	Silt loam.....	Brown to grayish-brown silt loam 6 to 8 inches thick.	Yellowish-brown compact silt loam to silty clay loam about 10 to 15 inches thick.
6. Imperfectly drained: Bracoville.....	Silt loam.....	Brownish-gray silt loam 6 inches thick.	Yellowish-brown silt loam.
Captina.....	Silt loam.....	Brown to grayish-brown silt loam 6 to 8 inches thick.	Yellowish-brown moderately heavy silt loam.
Monongahela.....	Silt loam..... Silt loam, high terrace phase.	Grayish-brown or brownish-gray silt loam 6 to 8 inches thick.	Yellowish-brown heavy silt loam mottled with yellow and gray below 15 to 20 inches.
7. Poorly drained soils on uplands and terraces: Blago.....	Silty clay loam.....	Grayish-black silty clay loam 8 inches thick. Numerous concretions throughout the profile. "Buckshot" appearance.	Mottled bluish-gray and yellowish-brown silty clay.
Mullins.....	Silt loam.....	Gray to slightly brownish-gray silt loam 4 to 6 inches thick.	Very light-gray silt loam 6 to 10 inches thick. Many small irregular yellowish-brown concretions.
Tyler.....	Fine sandy loam..... Loam. Silt loam.	Gray to brownish-gray silt loam 8 to 10 inches thick.	Mottled gray and yellowish-brown silty clay loam, heavy, blocky, and compact.
8. Alluvial soils: a. Well-drained: Huntington.....	Fine sandy loam..... Loam. Sandy loam. Silt loam. Silt loam, high bottom phase.	Rich brown to dark brown; 6 inches thick.	Dark brown with very little difference in color to a depth of 3 feet or more.
Chagrin.....	Fine sandy loam..... Loam. Silt loam.	Grayish-brown to rich brown; mellow; 8 to 12 inches thick.	Yellowish-brown to pale yellowish-brown slightly compact silty alluvium to depths of several feet.
Moshannon.....	Silty clay loam.....	Dark-brown silty clay loam with a slight reddish cast; 6 to 8 inches thick.	Reddish-brown slightly compact silty clay loam about 36 inches thick.
Pope.....	Fine sandy loam..... Loam. Sandy loam. Silt loam.	Brown to light brown; 8 inches thick.	Brown to yellowish brown.

Muskingum and Guernsey Counties—Continued

Parent (or underlying material)	Natural drainage		Distribution in Muskingum and Guernsey Counties	Remarks
	Surface	Internal		
Limestone, red and gray shale, and gray sandstone below 24 to 36 inches.	Good	Good	Rolling to steep areas mainly in southeastern Muskingum County and southwestern Guernsey.	Slightly acid. Texture and color of both surface soil and subsoil variable, depending on relative amounts of Brocko, Muskingum, and Upshur. Slips and landslides common.
Limestone and calcareous shale below 18 to 36 inches.	do	Fair	Small rolling to hilly areas, mostly in southern part of the two counties.	Slightly acid to alkaline. Good alfalfa soil.
Interbedded limestone, gray acid and calcareous shales, and some sandstone below 24 to 36 inches.	do	Good	Extensive in the southern part of the two counties. Narrow rolling ridge tops and rolling or steeply rolling and severely dissected country.	Slightly acid. Slips and landslides common.
Stratified sand and gravel below 24 to 40 inches. Glacial outwash.	do	Good to excessive	Along the larger streams in Muskingum County. Large areas at Trinway, Dresden, and along east side of Muskingum River south of Zanesville.	Moderately to strongly acid. The gravelly loam, loam, and sandy loam tend to be somewhat droughty.
Laminated sands and clay below 36 to 48 inches. Wash from Westmoreland areas.	do	Good	Benches mainly along Leatherwood Creek and its tributaries in Guernsey County.	Slightly acid.
Laminated sand, silt, and some clay below 40 to 60 inches or more. Wash from Muskingum areas.	do	do	Extensive in both counties along larger streams. High terrace phases less extensive. High stream benches and flat shoulder or saddle positions. Typical areas north and east of Zanesville and east and south of Chandlersville in Muskingum County.	Moderately to strongly acid.
Laminated reddish clay. Wash from Meigs and Upshur areas.	do	do	Undulating terraces mainly along Leatherwood Creek and in the vicinity of Olbison and Salesville in Guernsey County.	Do.
Stratified sand and gravel below 24 to 36 inches.	Fair	Poor	Small areas on the glacial wash terraces along the Licking and Muskingum Rivers north and west of Zanesville in Muskingum County.	Very strongly acid.
Laminated silt and clay below 24 to 40 inches. Wash from Westmoreland areas.	Good	Fair	Mainly on terraces along Leatherwood Creek and its tributaries in Guernsey County from Lore City east to county line.	Slightly to moderately acid. Depth to underlying material ranges from 2 to 8 or 10 feet. Few poorly drained areas (Robertsville) included in this type.
Laminated silt and clay below 36 to 48 inches. Wash from Muskingum areas.	Fair	Poor	Terraces scattered over the two counties. The high terrace phase is associated with the Holston, high terrace phase.	Strongly acid.
Laminated silt and clay below 30 to 40 inches. Wash from Muskingum areas.	Poor	do	Old valleys. In association with the Tyler and Monongahela soils. Mainly in small areas in the northwestern Muskingum County near Township Hall.	Good corn soil if adequately drained. Strongly acid.
Sandstone, siltstone, or shale at depths from 4 to about 8 feet.	do	Very poor	Upland flats and streamhead depressions in very small scattered areas.	Very strongly acid.
Laminated silt and clay below 30 to 40 inches. Wash from Muskingum areas.	do	do	Terrace benches along the larger streams. Scattered throughout the two counties.	Do.
Wash from uplands containing Westmoreland soils.	Good	Good	First bottoms along streams that drain uplands containing some Westmoreland soils.	Neutral to slightly alkaline.
Stratified materials washed from glacial shale and sandstone upland soils influenced by limestone.	do	do	First bottoms along Wakatomika Creek, and upper Muskingum River.	Neutral to slightly acid.
Wash from uplands containing Belmont, Meigs, and Upshur soils.	do	do	First bottoms along the small streams that drain uplands containing areas of Belmont, Meigs, and Upshur soils.	Neutral to slightly alkaline.
Wash from uplands containing Muskingum soils.	do	do	First bottoms along streams that drain uplands containing Muskingum soils.	Acid.

TABLE 16.—Characteristics of soils in Musk

Soil group and series	Soil types mapped	Soil profile		
		Surface soil	Subsoil	Lower subsoil
7. Alluvial soils—Continued. b. Imperfectly drained				
Landside	Silt loam	Brown to grayish-brown silt loam 6 inches thick.	Brown. Slightly compact. Below 15 to 18 inches gray-brown silty clay loam mottled with light gray, rust brown, and yellow to 35 or 40 inches.	
Lobdell	Silty clay loam	Grayish-brown to dark grayish-brown silt loam; mellow; friable; 10 to 12 inches thick.	Brown or yellowish-brown friable silt loam; slightly more compact than surface; 10 to 12 inches thick.	Mottled gray, yellow, and rust-brown silt loam.
Philo	Loam Silt loam	Light brown or grayish brown; 8 inches thick.	Gray brown gradually shading into a more yellowish brown.	Mottled brown, gray, and rust brown below 15 to 18 inches.
Senecaville	Silty clay loam	Grayish-brown silty clay loam with a reddish cast; 10 to 12 inches thick.	Grayish-brown clay loam with reddish cast, mottled with light yellow.	Grayish-brown clay loam mottled with yellow and gray. Compact below 15 to 18 inches.
g. Poorly drained:				
Atkins	Silt loam	Gray silt loam with rust-brown and dark-gray streaks; 6 inches thick.	Mottled gray, yellow, and rust-brown, heavy silt loam or silty clay loam. Compact and plastic; 3 to 4 feet thick.	
Melvin	Silt loam	Brownish-gray silt loam mottled with light gray and rust brown; 6 inches thick.	Gray mottled with yellowish gray and rust brown, very heavy, compact silty clay loam 30 to 50 inches thick.	
Holly	Silt loam	Gray or grayish-brown; mellow; floury; in places mottled with rust brown; 4 to 10 inches thick.	Gray or grayish-yellow-floury silt loam or light silty clay loam; mottled with rust brown and yellow.	
Miscellaneous soils not suitable for cultivation:				
Muskingum	Stony loam	Grayish-brown loam 4 to 10 inches deep; numerous rock fragments.	Grayish-yellow loam	
	Stony silt loam	Grayish-brown silt loam 4 to 8 inches thick; numerous sandstone fragments.	Grayish-yellow silt loam	
Stony land, Muskingum soil material.		Where present, surface soil resembles Muskingum stony silt loam or stony loam.	Resembles Muskingum stony silt loam or stony loam.	

TABLE 17.—Extent of each soil type, and the distribution in

Soil group and series	Soil types mapped	Muskingum County											
		Area		Slope		Erosion		Present land use					
		Acres	Pct. 1	Class 2	Acres	Pct. 3	Group 4	Acres	Pct. 5	Class 5	Acres	Pct. 7	
Shallow soils developed on sandstone and shale or cherty limestone: Frankstown	Cherty silt loam	1,942	0.5	A	192	9.9	N	2	0.1	L	611	31.5	
				B	1,064	54.8	Sl	354	18.2	X	115	5.9	
				C	558	28.7	M	1,408	72.5	P	719	37.0	
				D	128	6.6	S	124	6.4	F	478	24.5	
	Loam	23,190	5.5	A	269	1.0	N	717	3.1	L	6,235	26.9	
				B	10,418	45.1	Sl	3,316	14.3	X	2,143	9.3	
				C	7,169	30.9	M	15,262	65.9	P	8,601	37.5	
				D	5,179	22.4	S	3,444	14.9	F	5,800	25.0	
	Muskingum	Silt loam	100,705	47.5	A	362	.2	N	2,678	1.3	L	17,645	8.6
					B	84,493	42.3	Sl	21,723	10.9	X	75,600	37.9
					C	57,031	29.0	M	46,220	23.1	P	57,767	28.9
					D	56,920	28.5	S	7,896	4.0	F	3,123	1.6
	Silt loam, colluvial phase	263	.1	A	35	13.8	N	44	17.4	L	52	20.0	
				B	203	80.3	Sl	49	19.4	X	7	2.8	
				C	15	5.9	M	136	63.7	P	180	71.1	
							S	5	2.0	F	11	4.3	
						VS	19	7.5	H	3	1.2		
Total		228,060	53.6										

See footnotes at end of table.

*type of slopes, erosion, present use, and land capability*—Continued

Muskingum County— Continued	Natural drainage		Distribution in Muskingum and Guernsey Counties	Remarks
	Surface	Internal		
Land capability from uplands contain- ing Westmoreland soils.	Fair to good	Poor	Flood plains on streams that drain uplands containing areas of Westmoreland soils.	Neutral to slightly alkaline. Swampy oak, sycamore, and walnut trees growing on the soil.
Stratified materials washed from glacial shale and sand- stone upland soils influenced by limestone.	Good	do.	First bottoms along Wakatomi- ka Creek, and upper Mus- kingum River.	Neutral to slightly acid
Wash from uplands contain- ing Muskingum soils.	Fair	do.	Flood plains along streams that drain uplands containing Mus- kingum soils.	Slightly acid
Wash from uplands contain- ing Belmont, Meigs, and Upsbur soils	Fair to good	do.	Flood plains of the smaller streams that drain uplands containing areas of Belmont, Meigs, and Upsbur soils.	Neutral to slightly alkaline
Wash from uplands contain- ing Muskingum soils.	Very poor	Very poor	Flood plains on streams that drain uplands containing Muskingum soils.	Very strongly acid. Too poorly drained to make artificial drainage profitable
Wash from uplands contain- ing Westmoreland soils.	do.	do.	Flood plains along streams that drain the uplands containing Westmoreland soils.	Moderately acid. Too poorly drained to make artificial drainage profitable
Stratified materials washed from glacial shale and sand- stone upland soils influ- enced by limestone.	do.	do.	Flood plains along Wakatomi- ka Creek and upper Muskingum River.	Slightly to moderately acid
Sandstone and shale. Bed- rock 18 to 20 inches from surface.	Excessive	Good	Steep slopes throughout the 2 counties.	Strongly acid. Derived largely from sand- stone rather than shale. Surface covered with sand- stone fragments ranging in size from several square inches to a square foot or more.
Sandstone and shale below 18 inches.	do.	do.	do.	Strongly acid. Derived largely from shales.
Sandstone and shale	do.	do.	Very steep slopes throughout the 2 counties.	Consists of very steep, eroded or stony land with rocky cliffs and hillsides.

*each soil type of slopes, erosion, present use, and land capability*

Muskingum County— Continued				Guernsey County												
Land capability			Area		Slope			Erosion			Present land use			Land capability		
Class	Acres	Pct.	Acres	Pct.	Class	Acres	Pct.	Group	Acres	Pct.	Class	Acres	Pct.	Class	Acres	Pct.
II	134	6.9	0													
III	1,078	55.5														
IV	123	6.3														
VI	403	20.8														
VII	204	10.5														
I	237	1.0	7,788	2.4	A	22	0.3	N	18	0.2	L	2,670	34.4	II	16	4.2
II	119	.5			B	4,033	51.8	SI	186	2.4	X	613	7.9	III	2,973	39.1
III	9,122	39.4			C	2,569	33.0	M	4,344	34.5	P	3,420	13.9	IV	1,979	13.7
IV	2,150	9.3			D	1,164	14.9	S	3,228	41.5	F	1,617	13.0	VI	1,917	11.1
VI	4,968	21.5						VS	112	1.4	H	69	.5	VII	2,715	24.9
VII	6,504	28.3														
I	38	(9)	133,107	40.2	A	350	.3	N	129	.1	L	34,691	26.0	I	43	(9)
II	290	.1			B	59,836	45.0	SI	3,010	2.3	X	10,644	8.0	II	69	.1
III	74,425	37.3			C	35,921	26.9	M	71,857	54.0	P	55,316	41.6	III	67,270	34.0
IV	14,978	7.5			D	37,000	27.8	S	55,656	41.8	F	30,115	22.6	IV	14,712	11.0
VI	34,911	17.5						VS	2,456	1.8	H	2,431	1.8	VI	13,616	9.9
VII	75,063	37.6												VII	26,293	15.1
I	33	13.0	83	(9)	B	41	49.4	M	64	77.1	L	6	10.9	III	39	34.2
II	2	.8			C	21	25.3	S	19	22.9	X	11	14.3	IV	1	1.2
III	162	64.0			D	21	25.3				P	39	47.9	VI	14	15.9
IV	29	11.5									F	21	27.7	VII	2	2.7
VI	24	9.5									H	1	1.2			
VII	3	1.2														
			140,978	42.6												

TABLE 17.—Extent of each soil type, and its distribution in each soil

Soil group and series	Soil types mapped	Muskingum County											
		Area		Slope		Erosion		Percent land use					
		Acres	Pct.	Class	Acres	Pct.	Group	Acres	Pct.	Class	Acres	Pct.	
2. Soils with heavy clay subsoils developed on shale and sandstone:													
Effort	Silt loam	441	.1	A	6	1.4	N	70	15.9	L	143	32.4	
				B	332	75.8	SI	68	14.3	X	62	20.9	
				C	103	23.3	M	192	43.6	P	193	33.7	
							S	6	1.4	F	6	1.4	
							VS	112	25.4	H	7	1.6	
							N	68	15.4	L	2,045	23.1	
							SI	640	7.2	X	806	9.1	
							M	6,333	71.6	P	4,634	52.4	
							S	1,120	12.7	F	1,313	14.9	
							VS	987	7.8	H	48	.5	
Meigs (Muskingum-Upshur)	Silty clay loam	8,946	2.1	A	28	.3	N	3	.6	L	207	40.8	
				B	418	82.5	SI	137	27.0	X	84	16.6	
				C	66	13.0	M	304	60.0	P	174	34.3	
							S	18	3.5	F	29	5.7	
							VS	45	8.9	H	13	2.6	
Rarden	Silt loam	507	.1	A	28	4.5	N	3	.6	L	207	40.8	
				B	418	82.5	SI	137	27.0	X	84	16.6	
				C	66	13.0	M	304	60.0	P	174	34.3	
							S	18	3.5	F	29	5.7	
							VS	45	8.9	H	13	2.6	
Upshur	Clay	64	(9)	A	16	29.6	SI	22	40.7	L	9	16.7	
				B	17	31.5	M	5	9.3	P	8	14.8	
				C	1	1.9	S	14	25.9	F	19	35.2	
				D	20	37.0	VS	13	24.1	H	18	33.3	
Total		9,648	2.3										
3. Deep soils developed on sandstone and shale:													
a. Well-drained, on shale and sandstone:													
Coolville	Silt loam	11	(9)	B	11	100.0	SI	2	18.2	X	4	36.4	
							M	9	81.8	P	5	45.4	
										F	2	18.2	
Guernsey	Silt loam	46	(9)	A	14	30.4	SI	14	30.4	L	21	45.7	
				B	32	69.6	M	32	69.6	X	10	21.7	
										P	2	4.3	
										F	18	28.3	
Keane	Silt loam	0											
Total		57	(9)										
b. Well-drained, on sandstone and shale:													
Hanover	Silt loam	1,267	.3	A	7	.6	SI	294	23.2	L	673	53.1	
				B	1,260	99.4	M	959	75.7	X	29	2.3	
							VS	14	1.1	P	446	35.2	
										F	72	5.7	
										H	47	3.7	
Wenston	Silt loam	26,177	6.2	A	894	3.4	N	3,917	15.0	L	10,751	41.1	
				B	24,167	92.3	SI	9,456	36.1	X	2,823	10.8	
				C	1,084	4.1	M	12,232	46.7	P	10,663	40.7	
				D	42	.2	S	475	1.8	F	1,289	4.9	
							VS	97	.4	H	661	2.5	
Zanesville	Silt loam	13,221	3.2	A	1,638	12.4	N	235	1.8	L	7,320	55.4	
				B	11,433	86.5	SI	8,666	64.8	X	1,260	9.5	
				C	70	.5	M	4,362	33.0	P	3,434	26.0	
				D	80	.6	S	41	.3	F	725	5.5	
							VS	17	.1	H	482	3.6	
Total		40,665	9.7										
c. Imperfectly drained:													
Tilist	Silt loam	2,987	.7	A	485	16.2	N	438	14.7	L	1,140	38.2	
				B	2,502	83.8	SI	1,323	44.3	X	218	7.3	
							M	956	32.0	P	1,500	50.2	
							S	263	8.8	F	112	3.7	
							VS	7	.2	H	17	.6	
Total		43,709	10.4										

See footnotes at end of table.

Muskingum and Guernsey Counties, present use, and land capability—Continued

Parent (or underlying material)						Guernsey County												
Fertility			Area			Slope			Erosion			Present land use			Land capability			
Class	Acres	Pct. <sup>1</sup>	Acres	Pct. <sup>1</sup>	Class <sup>2</sup>	Acres	Pct. <sup>1</sup>	Group <sup>3</sup>	Acres	Pct. <sup>1</sup>	Class <sup>4</sup>	Acres	Pct. <sup>1</sup>	Class <sup>5</sup>	Acres	Pct. <sup>1</sup>		
II	8	1.8	60	(9)	A	6	10.0	SI	2	3.3	L	25	41.7	II	2	3.3		
III	230	52.2			B	62	56.7	M	41	68.3	X	9	15.0	III	32	65.0		
IV	18	4.1			C	2	3.3	S	4	6.7	P	15	26.7	IV	4	6.7		
VI	102	23.1							VS	18	31.7	H	10	16.6	VI	10	16.6	
VII	85	19.8													VII	5	10.0	
I	14	2.2					A	204	1.6	N	12	.1	L	3,250	25.0	II	151	1.2
II	9	.1					B	7,246	57.8	SI	240	1.9	X	1,334	10.7	III	3,561	44.6
III	4,392	49.7	194	.1	C	3,738	29.8	M	7,327	58.5	P	5,693	45.4	IV	1,347	10.8		
IV	422	4.8					D	1,348	10.8	S	2,902	31.6	F	2,150	17.2	VI	1,703	13.6
VI	1,791	20.2							VS	995	7.9	H	98	.8	VII	2,760	20.9	
VII	2,218	25.0					A	107	55.2	N	2	1.0	L	93	47.9	II	57	29.4
I	3	.6					B	87	44.8	SI	53	29.9	X	17	8.8	III	118	60.8
II	20	3.9							M	115	60.2	P	78	40.2	IV	19	9.8	
III	402	79.3							S	19	9.8	F	2	1.0				
IV	9	1.8	19	(9)							H	4	2.1					
VI	24	4.7					A	2	10.5	M	3	15.8	P	18	94.7	III	3	15.8
VII	49	9.7					B	17	89.5	S	16	84.2	F	1	5.8	IV	10	54.2
I	16	29.6																
II	10	18.6																
III	7	13.0																
IV	1	1.8																
VI	20	37.1																
VII																		
			12,809	3.9														
II	2	18.2	328	.1	A	221	67.4	SI	50	15.3	L	189	57.7	II	225	68.6		
III	9	81.8			B	107	32.6	M	274	83.5	X	22	6.7	III	99	30.2		
								VS	4	1.2	P	104	31.7	VI	4	1.2		
II	14	30.4	4,048	1.2	A	178	4.4	N	20	.5	L	2,480	61.3	I	8	1.1		
III	32	69.6			B	3,841	94.9	SI	461	20.3	X	461	11.4	II	860	21.2		
					C	29	.7	M	2,681	66.2	P	945	23.3	III	2,890	66.4		
								S	437	10.8	F	129	3.2	IV	423	10.5		
								VS	90	2.2	H	33	.8	VI	13	.3		
			459	.1	B	459	100.0	SI	13	2.8	L	272	59.3	II	13	2.6		
										M	376	81.9	X	18	3.0	III	376	81.9
								S	54	11.8	P	137	29.8	IV	47	10.3		
								VS	16	3.6	F	32	7.0	VI	21	4.6		
														VII	2	.4		
			4,835	1.4														
II	204	23.2	0															
III	950	75.7																
VII	14	1.1																
I	12	(9)	6,450	2.0	A	983	15.3	N	6	.1	L	3,578	55.5	II	2,450	38.0		
II	12,542	47.9			B	5,464	84.7	SI	1,659	26.2	X	489	7.6	III	3,993	60.5		
III	12,009	45.9			C	3	(9)	M	4,661	72.2	P	1,814	28.1	IV	51	1.3		
IV	1,462	5.6							S	74	1.2	F	328	5.1	VI	3	(9)	
VI	78	.3							VS	20	.3	H	241	3.7	VII	13	.2	
VII	74	.3																
I	29	.2			20	(9)	B	20	100.0	SI	20	100.0	L	13	65.0	II	20	100.0
II	8,761	66.4																
III	4,260	32.2																
IV	46	.3																
VI	42	.3																
VII	83	.6																
			6,470	2.0														
II	1,657	55.5	1,231	.4	A	704	57.2	N	17	1.4	L	825	67.0	II	816	66.3		
III	900	30.1			B	527	42.8	SI	799	64.9	X	59	4.8	III	413	33.5		
IV	324	10.9							M	413	33.5	P	202	24.6	IV	2	.2	
VI	64	2.1							S	2	.2	F	17	1.4				
VII	42	1.4										H	27	2.2				
			12,536	3.8														



TABLE 17.—Extent of each soil type, and characteristics of soils in Muskingum County

Soil group and series	Soil types mapped	Muskingum County										Lower subsoil	
		Area		Slope		Erosion		Pta.		Pta.			
		Acres	Pct.	Class	Acres	Pct.	Group	Acres	Pct.	Class	Acres	Pct.	
4. Shallow soils developed on interbedded limestone, sandstone, and shale:	Belmont..... Silty clay loam.	14,111	3.4	B.....	7,374	52.3	N.....	32	.2	L.....	3,181	22.6	
				C.....	4,980	35.2	SI.....	665	4.0	X.....	696	4.7	
				D.....	1,757	12.6	M.....	10,881	77.2	P.....	3,426	24.4	
							S.....	1,190	8.4	F.....	1,750	12.4	
	Brooke..... Silty clay loam.	247	.1	A.....	43	17.4	VS.....	1,443	10.2	H.....	88	.6	
				B.....	161	65.2	SI.....	105	42.5	L.....	53	21.5	
				C.....	43	17.4	M.....	122	49.4	X.....	48	19.4	
							S.....	20	8.1	P.....	137	55.5	
	Westmoreland..... Silty clay loam.	31,824	7.6	A.....	401	1.3	N.....	385	1.2	L.....	9,638	30.3	
				B.....	20,944	65.8	SI.....	3,746	11.8	X.....	890	2.8	
			C.....	6,468	20.3	M.....	23,513	73.9	P.....	17,510	55.0		
			D.....	4,011	12.6	S.....	3,025	9.5	F.....	3,296	10.4		
Westmoreland..... Silty clay loam, colluvial phase.	216	.1	B.....	216	100.0	VS.....	1,156	3.0	H.....	481	1.5		
						N.....	5	2.3	L.....	32	14.8		
						SI.....	107	49.8	X.....	12	5.6		
						M.....	78	38.1	P.....	152	70.4		
Total.....	46,398	11.2				S.....	16	7.4	F.....	14	6.4		
						VS.....	10	4.6	H.....	6	2.8		
5. Soils on terraces: a. Well-drained:	Gravelly loam.....	981	.2	A.....	410	41.8	N.....	6	.6	L.....	444	45.3	
				B.....	183	18.7	SI.....	425	43.3	X.....	97	9.9	
				C.....	68	6.9	M.....	518	52.8	P.....	180	13.2	
				D.....	320	32.6	S.....	4	.4	F.....	273	27.8	
	Chenango..... Loam.....	1,001	.3	A.....	625	58.9	VS.....	28	2.9	H.....	37	3.8	
				B.....	375	35.3	N.....	37	3.5	L.....	641	60.4	
				C.....	57	5.4	SI.....	854	80.5	X.....	32	3.0	
				D.....	4	.4	M.....	166	15.6	P.....	202	19.0	
	Sandy loam.....	3,528	.8	A.....	2,217	62.9	S.....	4	.4	F.....	2	.2	
				B.....	1,207	34.2	N.....	14	1.4	H.....	184	17.4	
			C.....	19	.5	SI.....	3,246	92.0	X.....	1,796	50.9		
			D.....	85	2.4	M.....	268	7.6	P.....	303	8.6		
Silt loam, deep phase.....	2,872	.7	A.....	1,555	54.1	N.....	352	12.3	L.....	841	23.5		
			B.....	1,167	40.3	SI.....	2,064	71.9	X.....	425	11.5		
			C.....	119	4.2	M.....	432	15.0	P.....	419	14.6		
			D.....	41	1.4	S.....	21	.7	F.....	119	4.1		
Eik..... Silt loam.....	0		VS.....			H.....	3	.1	H.....	578	20.1		
Holston..... Loam.....	900	.2	A.....	359	39.3	N.....	71	7.2	L.....	600	60.6		
			B.....	501	55.6	SI.....	692	60.8	X.....	10	1.0		
			C.....	70	7.1	M.....	310	31.3	P.....	271	27.4		
						S.....	7	.7	F.....	43	4.3		
Loam, high terrace phase.....	195	(?)	H.....			H.....			H.....	57	5.8		
			A.....	42	21.5	N.....	24	12.3	L.....	115	58.9		
			B.....	153	78.5	SI.....	117	60.0	X.....	1	.5		
						M.....	54	27.7	P.....	41	21.1		
Sandy loam.....	80	(?)	F.....			F.....			F.....	33	16.9		
			A.....	60	75.0	N.....	4	5.0	L.....	6	2.6		
			B.....	20	25.0	SI.....	76	95.0	P.....	71	88.8		
						L.....			L.....	9	11.2		
Silt loam.....	9,251	2.2	A.....	2,210	24.0	N.....	813	8.8	L.....	4,392	47.5		
			B.....	6,531	70.6	SI.....	5,103	55.2	X.....	491	5.3		
			C.....	248	2.7	M.....	3,093	33.4	P.....	2,562	27.7		
			D.....	256	2.8	S.....	217	2.3	F.....	300	3.2		
Silt loam, high terrace phase.....	9,831	2.3	VS.....			H.....	25	.3	H.....	1,504	16.3		
			A.....	936	9.5	N.....	134	1.4	L.....	4,875	49.6		
			B.....	8,718	88.7	SI.....	4,105	42.4	X.....	1,200	12.2		
			C.....	177	1.8	M.....	5,389	54.8	P.....	2,935	29.9		
Vincent..... Silt loam.....	0		S.....			S.....	73	.7	F.....	453	4.6		
						VS.....	73	.7	H.....	368	3.7		
Total.....	28,789	6.7											

See footnotes at end of table.

*type of slopes, erosion, present use, and land capability—Continued*

Maskingum County—  
Continued

Guernsey County

Land capability			Area		Slope			Erosion			Present land use			Land capability				
Class	Acres	Pct.	Acres	Pct.	Class	Acres	Pct.	Group	Acres	Pct.	Class	Acres	Pct.	Class	Acres	Pct.		
III	5,815	41.2	30,934	9.4	A	95	3	SI	234	8	L	8,304	26.8	II	7	1		
IV	5,554	3.9			B	23,165	74.9	M	32,240	72.0	X	1,908	6.2	III	17,140	55.1		
VI	5,112	36.2			C	6,934	22.4	S	6,478	20.0	P	16,639	50.6	IV	2,163	7.0		
VII	2,630	18.7			D	740	2.4	VS	2,232	7.2	H	4,906	15.3	V	7,159	23.1		
II	43	17.4	96	(9)	B	75	78.1	SI	5	5.2	L	183	3.3	VII	3,303	10.7		
III	161	65.2			C	21	21.9	M	75	78.1	X	8	8.3	III	96	98.7		
IV	8	3.2							S	4	4.2	P	51	51.2	VI	21	21.9	
VI	15	6.1							VS	12	12.6	H	5	5.2	VII	9	9.1	
VII	20	8.1																
I	295	9			22,758	6.9	A	90	4	N	6	(9)	L	7,739	34.0	I	8	(9)
II	100	3					B	10,687	73.3	SI	510	2.3	X	1,111	4.9	II	27	1.1
III	18,639	58.6	C	4,339			19.1	M	17,223	75.7	P	10,876	47.8	III	13,306	50.4		
IV	1,208	3.8	D	1,642			7.2	S	4,511	19.8	H	2,628	11.6	IV	1,254	5.5		
VI	6,691	20.7					VS	508	2.2		404	1.8	V	5,140	22.6			
VII	4,991	15.7																
III	161	74.5	48	(9)	B	48	100.0	M	39	81.2	L	18	37.3	VII	2,001	11.8		
VI	55	25.5							S	9	18.8	P	31	64.6	III	36	75.0	
											H	1	2.1	IV	6	10.4		
														VI	7	14.6		
			53,836	16.3														
II	424	43.2	3	(9)	A	1	33.3	M	3	100.0	L	2	66.7	III	3	100.0		
III	169	17.2			B	2	66.7					P	1	33.3				
VII	388	30.6																
I	37	3.5	0															
II	854	80.8																
III	109	10.3																
VII	61	5.7																
I	14	4	0															
II	3,242	91.9																
III	168	4.8																
VII	104	2.9																
I	352	12.3	297	.1	A	5	1.7	SI	179	60.3	L	177	59.6	II	179	60.3		
II	2,046	71.2			B	292	98.3	M	118	39.7	X	10	3.4	III	118	39.7		
III	299	10.4										P	87	29.3				
IV	12	4										H	23	7.7				
VI	11	4																
VII	162	5.3																
					182	.1	A	2	1.1	SI	9	4.9	L	79	43.5	II	9	5.0
					B	180	98.9	M	170	98.4	X	1	.5	III	170	98.4		
								VS	3	1.7	P	101	53.5	VI	1	.6		
											H	1	.6	VII	2	1.1		
I	83	6.4	86	(9)	A	17	19.8	SI	32	37.2	L	70	81.4	II	32	37.2		
II	610	61.0			B	59	68.6	M	35	40.7	X	2	2.3	III	45	49.7		
III	247	24.9			C	10	11.6	S	19	22.1	P	8	9.3	IV	9	10.5		
VII	70	7.1										H	2	2.3	VII	10	11.6	
I	24	12.3	0															
II	117	60.0																
III	54	27.7																
II	80	100.0	1	(9)	A	1	100.0	SI	1	100.0	X	1	100.0	II	1	100.0		
I	718	7.8					B	590	17.4	N	13	4	L	1,712	60.4	I	2	1
II	5,194	56.1	3,395	1.0	B	1,790	52.7	SI	829	24.4	X	225	6.6	II	825	24.3		
III	2,750	29.7			C	845	24.9	M	1,616	47.6	P	1,124	33.1	III	1,347	40.9		
IV	80	9			D	171	5.0	S	141	4.2	P	141	4.2	IV	124	3.7		
VI	9	1					VS	22	.6	H	193	5.7	V	22	.7			
VII	500	5.4																
I	134	1.4	300	.1	A	14	4.7	SI	86	28.7	L	160	53.6	II	66	21.7		
II	4,150	42.2			B	281	93.7	M	202	67.3	X	1	.3	III	292	97.3		
III	5,240	53.3			C	5	1.6	S	10	3.3	P	55	18.3	IV	5	1.7		
IV	57	.6					VS	2	.7	H	8	2.6	V	2	.6			
VI	74	.7																
VII	178	1.8																
			151	(9)	A	9	6.0	SI	31	20.5	L	60	39.7	III	31	20.5		
					B	142	94.0	M	118	78.2	P	91	60.3	II	119	78.2		
							S	2	1.3					IV	2	1.3		
			4,415	1.3														

TABLE 17.—Extent of each soil type, and in

Soil group and series	Soil types mapped	Muskingum County											
		Area		Slope		Erosion		Preservation		Present			
		Acres	Pct. (%)	Class	Acres	Pct. (%)	Group	Acres	Pct. (%)	Class	Acres	Pct. (%)	
5. Soils on terraces—Continued. b. Imperfectly drained: Bruceville.	Silt loam.	195		A	177	90.8	N	12	6.2	L	99	50.8	
				B	18	9.2	SI	180	92.3	X	19	9.7	
							M	3	1.5	P	13	6.7	
	Carpina	Silt loam.	256	.1	A	1	.4	N	1	.4	L	117	45.7
					B	255	99.6	SI	1	.4	X	2	.8
								M	254	99.2	P	115	44.9
	Monongahela	Silt loam.	9,072	2.2	A	4,777	52.7	N	1,164	12.8	L	5,099	56.2
					B	4,029	44.3	SI	6,022	66.5	X	476	5.2
					C	161	1.8	M	1,718	18.9	P	2,752	30.4
					D	105	1.2	S	156	1.7	F	234	2.6
		Silt loam, high-terrace phase.	982	.2	A	304	40.1	N	12	.1	H	511	5.6
					B	561	57.1	SI	10	1.0	L	602	61.3
					C	27	2.8	M	679	69.2	X	105	10.7
								S	250	25.5	P	238	24.2
							VS	22	2.2	F	30	3.1	
						VS	21	2.1	H	7	.7		
Total			10,605	2.5									
Total			39,294	9.2									
6. Poorly drained soils on uplands and terraces: Blago.	Silty clay loam.	1,467	.3	A	1,428	97.3	N	174	11.9	L	862	58.8	
				B	39	2.7	SI	1,211	82.5	X	89	6.1	
							M	35	2.4	P	422	28.7	
	Mullins	Silt loam.	83	(%)	A	75	90.4	N	47	3.2	F	90	6.1
					B	8	9.6	M	8	9.6	H	4	.3
	Tyler	Silt loam.	4,492	1.1	A	4,149	92.4	N	1,522	33.9	L	1,923	42.8
					B	343	7.6	SI	2,681	64.1	X	261	5.8
							M	74	1.7	P	1,869	41.6	
							VS	15	.3	F	300	6.7	
	Total		6,042	1.4									
	7. Alluvial soils: a. Well-drained:	Fine sandy loam.	410	.1	A	404	98.5	N	392	95.6	L	280	68.2
					B	6	1.5	SI	18	4.4	X	12	2.9
		Loam.	4,020	1.0	A	3,960	99.0	N	3,975	98.9	L	3,085	76.7
					B	40	1.0	SI	23	.6	X	237	5.9
							M	22	.5	P	180	4.5	
Huntington?		Sandy loam.	3,354	.8	A	2,873	85.7	N	2,624	78.2	L	2,024	60.3
					B	481	14.3	SI	529	15.8	X	431	12.9
							M	201	6.0	P	263	7.8	
Silt loam.		7,289	1.7	A	7,186	98.6	N	6,660	91.4	L	4,026	55.2	
				B	103	1.4	SI	622	8.5	X	271	3.7	
							M	7	.1	P	1,680	23.1	
Silt loam, high bottom phase. Silty clay loam.		93	(%)	A	93	100.0	N	77	82.8	L	85	91.4	
	317	.1	A	264	83.3	SI	16	17.2	X	8	8.6		
			B	53	16.7	N	292	92.1	L	44	13.9		
						SI	15	4.7	X	4	1.3		
Pope	Fine sandy loam.	459	.1	A	459	100.0	N	459	100.0	L	261	56.9	
	Loam.	103	(%)	A	103	100.0	N	92	89.3	L	91	88.4	
							SI	11	10.7	X	61	58.3	

See footnotes at end of table.

Muskingum and Guernsey Counties, Ohio, present use, and land capability—Continued

Parent (or underlying) material			Guernsey County													
Land capability			Area		Slope			Erosion			Present land use			Land capability		
Class	Acres	Pct. <sup>1</sup>	Acres	Pct. <sup>2</sup>	Class <sup>3</sup>	Acres	Pct. <sup>3</sup>	Group <sup>4</sup>	Acres	Pct. <sup>3</sup>	Class <sup>5</sup>	Acres	Pct. <sup>3</sup>	Class	Acres	Pct. <sup>3</sup>
II	192	98.5	1	(0)	B	1	100.0	N	1	100.0	P	1	100.0	II	1	100.0
III	3	1.5														
II	2	.8	1,667	.5	A	407	24.4	SI	382	22.9	L	844	50.0	II	382	22.9
III	254	99.2			B	1,260	75.6	M	1,265	75.8	X	84	5.0	III	1,265	75.8
											P	684	41.1	IV	30	1.8
											F	11	.7			
											H	44	2.6			
II	7,163	78.0	6,723	2.0	A	2,388	35.5	N	191	2.8	L	3,000	83.5	II	3,537	52.0
III	1,578	17.4			B	3,952	58.8	SI	3,349	49.8	X	300	4.5	III	2,019	39.0
IV	67	.7			C	306	4.6	M	2,747	40.9	P	1,909	28.4	IV	178	2.6
VI	3	(0)			D	77	1.1	S	405	6.0	F	148	2.2	VI	7	.1
VII	261	2.9						VS	31	.6	H	768	11.4	VII	382	6.7
II	689	70.2	245	.1	A	6	2.5	SI	123	50.2	L	202	82.5	II	123	50.2
III	232	23.6			B	234	95.5	M	122	49.8	X	5	1.2	III	117	47.8
IV	22	2.2			C	5	2.0				P	37	18.1	VII	8	2.0
VI	12	1.2									H	8	1.2			
VII	27	2.8														
			8,636	2.6												
			13,051	3.9												
IV	1,467	100.0	0													
IV	83	100.0	5	(0)	A	5	100.0	SI	5	100.0	L	6	100.0	IV	5	100.0
IV	4,492	100.0	2,510	.8	A	2,365	94.2	N	200	8.0	L	1,122	44.7	IV	2,510	100.0
					B	145	5.8	SI	2,220	88.4	X	83	3.3			
								M	89	3.6	P	653	26.0			
								S	1	(0)	F	32	1.8			
			2,515	.8							H	620	24.7			
I	404	98.5	0													
II	6	1.5														
I	3,980	99.0	13	(0)	A	9	69.2	N	9	69.2	L	4	30.8	I	9	69.2
II	40	1.0			B	4	30.8	M	4	30.8	P	9	69.2	II	4	30.8
I	2,873	85.7	3	(0)	B	3	100.0	SI	3	100.0	L	2	66.7	II	3	100.0
II	481	14.3									F	1	33.3			
I	7,185	98.6	689	.2	A	688	99.9	N	688	99.9	L	313	45.4	I	688	99.9
II	104	1.4			B	1	.1	M	1	.1	X	36	5.2	II	1	.1
											P	288	41.8			
											F	62	7.6			
I	93	100.0	0													
I	264	83.3	1,348	.4	A	1,336	99.1	N	1,332	98.8	L	636	47.1	I	1,336	99.1
II	53	16.7			B	12	.9	SI	13	1.0	X	29	2.1	II	12	.9
								M	3	.2	P	594	44.1			
											F	94	6.2			
											H	6	.5			
I	459	100.0	203	.1	A	203	100.0	N	203	100.0	L	148	72.9	I	203	100.0
											X	5	2.5			
											P	50	24.6			
I	303	100.0	245	.1	A	245	100.0	N	245	100.0	L	166	67.8	I	245	100.0
											X	17	6.9			
											P	59	24.1			
											F	3	1.2			

TABLE 17.—Extent of each soil type, and its distribution in each soil

Soil group and series	Soil types mapped	Muskingum County													
		Area		Slope		Erosion		Present land use							
		Acres	Pct.¹	Class²	Acres	Pct.³	Group⁴	Acres	Pct.⁵	Class⁶	Acres	Pct.⁷			
7. Alluvial soils—Continued. a. Well-drained—Continued.	Sandy loam	102		A	102	100.0	N			L	53	52.0			
										X	3	2.9			
										P	20	19.6			
										F	26	25.5			
Popo—Continued.	Silt loam	3,229	.8	A	3,201	99.1	N	3,189	98.8	L	1,462	45.3			
				B	28	.9	Sl	27	.8	X	1,189	36.9			
										M	13	.4			
										P	296	9.2			
										F	98	3.0			
Total		19,376	4.6												
b. Imperfectly drained: Lindside	Silt loam	1,802	.4	A	1,778	98.7	N	1,779	98.7	L	904	50.2			
				B	24	1.3	Sl	18	1.0	X	85	4.7			
	Loam	51	0	A	51	100.0	N	51	100.0	P	591	82.8			
											F	216	22.0		
												H	6	.8	
												L	33	64.7	
Philo	Silt loam	8,070	2.1	A	8,836	98.5	N	8,600	98.1	L	3,562	39.7			
				B	134	1.5	Sl	158	1.6	X	512	5.7			
												P	3,802	42.4	
												F	899	10.0	
									H	195	2.2				
Total		10,823	2.5												
c. Poorly drained: Atkins	Silt loam	6,973	1.6	A	6,905	99.0	N	6,905	99.0	L	1,440	20.7			
				B	68	1.0	Sl	59	.9	X	828	9.0			
	Melvin	Silt loam	1,161	.8	A	1,001	91.4	N	1,041	89.7	P	4,079	58.5		
					B	100	8.6	Sl	92	7.9	F	710	10.2		
													H	110	1.6
													L	418	36.0
										X	110	9.5			
										P	419	36.1			
										F	209	18.0			
										H	5	.4			
Total		6,134	1.9												
Total		38,333	9.0												
8. Miscellaneous soils not suitable for cultivation: Muskingum	Stony loam	4,125	1.5	A	37	.6	N	74	1.2	L	838	13.7			
				B	961	15.7	Sl	118	1.9	X	298	4.9			
				C	1,081	17.6	M	3,529	57.6	P	2,373	38.7			
				D	4,046	66.1	S	2,399	39.2	F	2,569	41.9			
	Stony silt loam	1,123	.3	B	547	48.7	VS	5	.1	H	47	.8			
				C	543	48.4	Sl	41	3.7	L	179	15.9			
				D	33	2.9	M	982	87.4	X	19	1.7			
												P	678	60.4	
	Stony land, Muskingum soil material	4,817	1.1	B	279	5.8	Sl	21	.3	F	244	21.7			
				C	961	19.9	M	2,893	60.1	X	147	3.1			
				D	3,577	74.3	S	1,891	39.3	P	1,579	32.8			
												F	2,857	59.3	
									H	30	.6				
Total		12,065	2.9												
Total		420,749	100.0												

¹ Percent of county.

² Slope limits on the Belmont, Brooke, and Westmoreland soils are A, less than 5 percent; B, 5-25; C, 25-40; and D, 40 and over. On all other soils, the slope limits are A, less than 5 percent; B, 5-20; C, 20-30; and D, 30 and over.

³ Percent of soil type.

⁴ N = no apparent, Sl = slight, M = moderate, S = severe, and VS = very severe.

⁵ L = woodland, X = idle land, P = pasture, F = woodland, and H = farmyards and urban areas.

⁶ Less than 0.1 percent.

⁷ Data for the Muskingum series include those for the Chagrin series; those for Lindside silt loam, Lobdell silt loam; and those for Melvin silt loam, Holly silt loam.

⁸ There are also 1,877 acres of mine pits, dumps, and quarries in Muskingum County and 231 acres in Guernsey County. Slopes, erosion, and land use were not classified on these areas.

Guernsey County

Area		Slope		Erosion		Present land use		Land capability							
Acres	Pct. (%)	Acres	Pct. (%)	Class	Acres	Pct. (%)	Group	Acres	Pct. (%)	Class	Acres	Pct. (%)	Class	Acres	Pct. (%)
102	100.0	5	(*)	B	5	100.0	M	5	100.0	X	5	100.0	II	5	100.0
3,201	99.1	1,577	.3	A	1,577	100.0	N	1,572	99.7	L	789	49.6	I	1,577	100.0
25	.9						Sl	5	.3	X	80	5.6			
										P	478	30.0			
										F	192	12.2			
										H	41	2.6			
		4,063	1.3												
1,602	100.0	11,658	3.5	A	11,653	100.0	N	11,574	99.3	L	6,178	53.0	II	11,658	100.0
				B	5	(*)	Sl	84	.7	X	520	4.5			
										P	3,968	34.0			
										F	794	6.8			
										H	220	1.9			
51	100.0	374	.1	A	374	100.0	N	374	100.0	L	152	40.7	II	374	100.0
										X	21	5.6			
										P	150	42.5			
										F	36	9.6			
										H	6	1.6			
8,970	100.0	10,990	3.3	A	10,990	100.0	N	10,931	99.5	L	4,953	45.0	II	10,990	100.0
							Sl	59	.5	X	479	4.4			
										P	4,735	43.1			
										F	604	5.5			
										H	129	1.2			
		3,965	1.2	A	3,964	100.0	N	3,964	100.0	L	1,890	47.7	II	3,965	100.0
				B	1	(*)	Sl	1	(*)	X	95	2.4			
										P	1,778	44.8			
										F	197	5.0			
										H	5	.1			
		28,987	8.1												
6,973	100.0	6,373	1.9	A	6,370	99.9	N	6,367	99.8	L	1,772	27.8	IV	6,373	100.0
				B	3	.1	Sl	3	.1	X	802	7.9			
							M	3	.1	P	3,503	35.0			
										F	536	8.4			
										H	60	.9			
1,161	100.0	5,888	1.7	A	5,886	100.0	N	5,882	99.9	L	1,549	27.7	IV	5,888	100.0
				B	2	(*)	Sl	4	.1	X	1,215	21.7			
							M	2	(*)	P	2,218	39.7			
										F	579	10.4			
										H	27	.5			
		11,961	3.6												
		43,081	13.0												
589	14.5	34,706	10.6	A	25	.1	N	20	.1	L	8,186	15.0	VI	3,890	11.2
5,236	85.5			B	6,467	18.6	Sl	400	1.1	X	2,134	6.1	VII	30,517	88.8
				C	11,260	32.4	M	13,378	38.5	P	12,975	37.4			
				D	16,954	48.9	S	20,192	58.2	F	24,295	71.2			
							VS	716	2.1	H	116	.3			
544	48.4	780	.2	A	3	.4	Sl	8	.2	L	213	27.1	VI	167	21.2
579	51.6			B	326	41.5	M	216	27.5	X	81	10.3	VII	619	78.8
				C	324	41.2	S	503	64.0	P	340	42.5			
				D	133	16.9	VS	59	7.5	F	100	12.7			
										H	3	.4			
276	5.7	16,482	5.0	B	1,131	6.9	N	4	(*)	L	550	3.4	VI	790	4.8
4,541	94.3			C	2,283	13.8	Sl	307	1.9	X	375	2.3	VII	15,692	95.2
				D	13,068	79.3	M	7,894	47.8	P	4,434	26.9			
							S	8,234	50.0	F	11,042	67.2			
							VS	43	.3	H	32	.2			
		51,974	15.7												
		330,720	100.0												