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SOIL SURVEY

Marshall County West Virginia



UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
WEST VIRGINIA AGRICULTURAL EXPERIMENT STATION

HOW TO USE THE SOIL SURVEY REPORT

THE PURPOSE of this report is to make information available to anyone who wants to know about the soils of Marshall County and how to use them. Different readers will be interested in different parts of the report. Farmers will be primarily interested in the kinds of soils and in the use and management of these soils on a particular farm. Engineers will be interested in the section Engineering Applications, and foresters, in the section Use and Management of Woodlands.

A soil survey is an inventory of the physical land resources. This report contains a description of each kind of soil and suggestions for its use. The kinds of soil are shown on the detailed soil maps in the back of the report. In making the survey, soil scientists walked over the land. They used a soil auger or spade and examined the different layers of the soil to identify its characteristics. They marked on an aerial photograph the extent of each kind of soil. They described the characteristics of each soil, including its slope and the amount of erosion that had taken place.

Use the index to map sheets to locate a farm or tract of land. Streams, roads, and other landmarks will help in doing this. Each soil area is set off by red lines and is marked by a symbol, for example, Bc. The soil for which this symbol stands is identified by the legend that accompanies the maps. Thus, all areas marked Bc are Brookside silt loam, 3 to 8 percent slopes. For a description of that soil, turn to the section Descriptions of Soil Series and Mapping Units. If interested in the use and management of that soil, note the capability unit given at the end of the soil description and turn to it in the section on use and management under the heading Capability Units.

* * * * *

Fieldwork for this survey was completed in 1957. Unless otherwise specifically indicated, all statements in the report refer to conditions in the county at that time.

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SOIL SURVEY OF MARSHALL COUNTY, WEST VIRGINIA

Soils surveyed by MERRILL KUNKLE, JOSEPH D. RUFFNER, and JOHN WEBB, Soil Conservation Service, United States Department of Agriculture

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United States Department of Agriculture in cooperation with the West Virginia Agricultural Experiment Station

General Nature of the Area

Marshall County forms the base of the northern Panhandle of West Virginia. The total area of the county is 195,840 acres, or 306 square miles. The Ohio River is on the western border (fig. 1). All of the waters in the county drain into the Ohio River through Wheeling Creek, Fish Creek, and Grave Creek. In general, the county is a highly dissected plateau, or plain. Elevations range from about 600 feet to 1,600 feet.

Based on the 38-year record, the average length of the growing season is 169 days. The average date of the last frost in spring is April 30, and the average date of the first frost in autumn is October 16. Frosts have occurred as late as June 1 and as early as September 26.

Most of the precipitation in the county falls during the growing season. Short droughts sometimes occur during the summer months.

TABLE 1.—Temperature and precipitation at New Martinsville, Wetzel County, West Virginia
[Elevation, 637 feet]

Month	Temperature ¹			Precipitation ²			
	Average	Absolute maximum	Absolute minimum	Average	Driest year (1930)	Wettest year (1945)	Average snowfall
December	35.3	74	-11	3.56	2.00	2.85	4.0
January	33.1	79	-18	3.98	2.02	3.69	6.3
February	33.5	78	-25	2.84	3.65	4.46	4.9
Winter	34.0	79	-25	10.38	7.67	11.00	15.2
March	43.3	89	-12	3.79	4.15	6.71	3.2
April	53.1	96	6	3.50	1.65	3.44	.6
May	63.0	99	25	3.67	2.50	5.13	(³)
Spring	53.1	99	-12	10.96	8.30	15.28	3.8
June	71.1	102	32	4.11	2.26	6.07	(³)
July	75.2	106	40	4.49	1.72	3.94	0
August	73.7	109	43	3.89	.95	3.52	0
Summer	73.3	109	32	12.49	4.93	13.53	(³)
September	68.5	100	32	3.03	1.37	10.16	0
October	56.8	97	16	3.12	.90	1.62	.3
November	44.8	85	2	2.84	.88	6.33	1.7
Fall	56.7	100	2	8.99	3.15	18.11	2.0
Year	54.3	109	-25	42.82	24.05	57.92	21.0

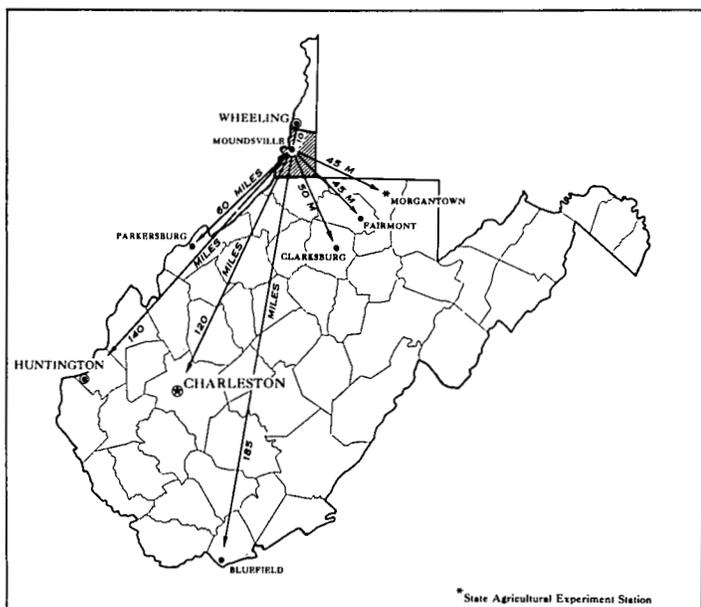


Figure 1.—Location of Marshall County in West Virginia.

Climate

The climate of Marshall County is cool and moist (5).¹ The temperature and precipitation are fairly uniform throughout the county. Table 1 shows the annual temperature and precipitation at New Martinsville in Wetzel County, which borders Marshall County on the south. At that station, the average annual temperature is 54.3° F., and the extreme range is from 109° to -25°. In January, the average is 33.1°, and in July, 75.2°.

¹ Number in italics refers to Literature Cited, p. 50.

¹ Average temperature based on a 62-year record, through 1955; highest temperature on a 58-year record, and lowest temperature on a 57-year record, through 1952.

² Average precipitation based on a 61-year record, through 1955; wettest and driest years based on a 61-year record, in the period 1893-1955; snowfall based on a 56-year record, through 1952.

³ Trace.

Agriculture

The county was settled in 1775, and for about the first 50 years most of the farms were on bottom lands and terraces along the Ohio River. Older settlements on the lower Mississippi needed flour, and farmers in this county eventually cleared much hill land to produce corn, wheat, and rye for sale down river. They also sold grain to drovers who moved cattle through the county from the midwest to eastern markets. By 1840, the fertility of the soils had been seriously depleted by grain production and erosion. Much of the land was abandoned and allowed to grow up in weeds, grasses, and trees.

By about 1900, there was considerable industry along the Ohio River. Industries brought a good demand for farm products, and farmers diversified their crops. Cattle raising, dairy farming, and truck farming were practiced.

Farming is now diversified, but dairying is the leading enterprise. The hay and grain raised are fed on the farm. The farms average 114 acres in size. Many farmers raise sheep. Most of them raise meat-type animals that shear a good grade of wool. A few farmers raise the breeds that produce fine-quality wool.

Most of the farming is on ridges because the narrow bottom lands along the smaller streams are bordered by steep hills, and because the bottom lands along the Ohio are preferred industrial sites.

Industry is now a very important part of the economy of the county. It affects the demand for farm products and the amount of labor available for farm work. As a result of the development of industries, some of the best farmland has been removed from production. Some shifts in land use are made, some of them in line with the capabilities of the land. The trend is for farmers to allow low-producing, steep, eroded farms to revert to woodland and supplement their income with part-time work in industry.

There are about 79,300 acres of woodland in Marshall County. The gradual retirement of some of the steeper eroded areas to woodland will increase this acreage. Most of the woodland in the county is on very steep slopes.

Agricultural Statistics

The statistics given in the following pages are based on reports of the United States Census of Agriculture or have been taken directly from those reports.

Land use.—In 1954, 150,588 acres, or more than three-fourths of the land area in Marshall County, was in farms. The number of farms, average size of farms, and land in farms in stated years are shown in table 2. In recent years the proportion of the county in farms has tended to decrease.

According to the 1954 census, there were 90 farms under 10 acres in size, 261 farms from 10 to 49 acres, 342 farms from 50 to 99 acres, 400 farms from 100 to 179 acres, 136 farms from 180 to 259 acres, 67 farms from 260 to 499 acres, 12 farms from 500 to 999 acres, and 3 farms of 1,000 acres and over.

In 1954, about 19 percent of all the land in farms was cropland harvested, and about 8 percent was cropland used

TABLE 2.—Number of farms, average size, and land in farms

Year	Farms		Land in farms	
	Number	Average size	Total	Proportion of county in farmland
1954	1,311	114.9	150,588	76.9
1950	1,495	106.4	159,038	81.2
1940	1,825	92.3	168,410	86.0
1930	1,606	102.0	163,783	82.6

only for pasture and cropland not harvested and not pastured. The total cropland, therefore, was about 27 percent of all the land in farms. Land use was reported in 1954 as follows:

Cropland:	<i>Acres</i>
Harvested	28,458
Used only for pasture	8,955
Not harvested and not pastured	3,712
Woodland:	
Pastured	17,757
Not pastured	20,856
Pasture (not cropland and not woodland)	66,876
Other land (house lots, roads, wasteland, etc.)	3,974

Crops.—The acreages of principal crops in stated years are shown in table 3. In 1954, the largest acreage was in hay crops. Corn has declined in acreage since 1929. Oats have also declined in the acreage grown.

TABLE 3.—Acreage of principal crops in stated years

Crop	1929	1939	1949	1954
Corn for all purposes	<i>Acres</i> 10,355	<i>Acres</i> 9,235	<i>Acres</i> 4,861	<i>Acres</i> 4,032
Harvested for grain	9,501	8,705	4,246	3,581
Cut for silage	773	517	582	446
Hogged or grazed, or cut for green or dry fodder	81	13	33	5
Small grains threshed or combined:				
Wheat	1,428	3,024	1,630	980
Oats	4,089	2,431	1,276	1,212
Barley	(1)	(1)	23	212
Other small grains	97	19	2	17
Soybeans grown for all purposes	362	592	328	326
Hay crops, total	22,663	19,039	22,075	20,689
Potatoes for home use or for sale	1,057	567	2,235	3,153

¹ Not reported.

² Does not include acreage for farms with less than 15 bushels harvested.

³ Does not include acreage for farms with less than 20 bushels harvested.

Livestock.—The number of livestock on farms in stated years is shown in table 4. In the period from 1930 to 1954, inclusive, the number of cattle has increased slightly. The general trend has been a decrease in all other livestock.

Types of farms.—The 1954 census reported 1,311 farms in the county. Of these, 683 farms were miscellaneous and unclassified; that is, farms producing mainly for the farm household, part-time farms, and the like. The remaining

TABLE 4.—Number of livestock on farms in stated years

Livestock	1930	1940	1950	1954
	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>
Cattle and calves.....	11, 507	¹ 10, 590	15, 832	15, 237
Cows milked.....	5, 611	6, 133	7, 687	7, 257
Horses and mules.....	2, 947	¹ 2, 799	2, 339	1, 577
Swine.....	6, 482	² 3, 840	4, 699	3, 936
Sheep and lambs.....	41, 550	³ 31, 757	16, 751	12, 847
Chickens.....	¹ 92, 870	² 76, 172	² 55, 664	² 53, 293
Turkeys raised.....	1, 682	2, 938	2, 372	1, 651
Ducks raised.....	1, 770	894	757	425

¹ Over 3 months old.³ Over 6 months old.² Over 4 months old.

628 farms were classified by major source of income as follows:

	<i>Number</i>
Dairy farms.....	450
Livestock farms other than dairy or poultry.....	88
General farms.....	35
Primarily crop.....	10
Primarily livestock.....	20
Crop and livestock.....	5
Poultry farms.....	25
Field-crop farms other than vegetable and fruit-and-nut.....	15
Fruit-and-nut farms.....	15

Farm tenure.—Most of the farmers in the county own the land they work. Only about 11 percent of the farms are operated by tenants. Farm tenure, as reported by the 1954 census, is as follows:

	<i>Number of farms</i>	<i>Acres in farms</i>
Full owners.....	1, 026	109, 036
Part owners.....	133	22, 263
Managers.....	2	2, 656
All tenants.....	150	16, 633
Cash tenants.....	69	6, 966
Share-cash tenants.....	2	373
Share tenants.....	22	3, 310
Croppers.....	14	1, 765
Other and unspecified tenants.....	43	4, 219

Soils of the County in General

In some parts of Marshall County, there are steep hills and narrow, sharp ridges; in other parts, there are steep hills and rather broad, rounded ridgetops. Along the Ohio River there is some nearly level land. These different land forms indicate different kinds of soils. If one digs into the soils and examines them closely, he finds a fairly regular, repeating pattern of soils for each land form. There are four such land forms in the county:

1. Hilly soils formed on shale, siltstone, sandstone, and some limestone: Westmoreland.
2. Hilly, rough soils formed on acid sandstone, acid shale, and calcareous red shale: Gilpin-Upshur.
3. Hilly soils formed on interbedded, acid, gray shale and sandstone: Gilpin.
4. Nearly level soils on terraces and flood plains of the Ohio River: Wheeling-Huntington.

These four main land forms, or soil associations, are shown on the colored map in the back of this report.

Hilly soils formed on shale, siltstone, sandstone, and some limestone: Westmoreland.—This area makes up most of the northern two-thirds of the county. It is a series of

long, detached hills and knobs cut up by narrow, V-shaped valleys. The highest points are almost at the same level. Viewed from one of these points, the horizon appears nearly level. The streams are in narrow V-shaped valleys that have very steep walls. The valley walls are particularly steep along the larger streams. A typical part of this soil association is shown in figure 2.

The dominant soils in this area are the moderately deep, well-drained, lime-influenced Westmoreland soils. Other upland soils that occur in this area are the Guernsey, Brooke, and Gilpin. Guernsey soils are moderately deep and have a claypan at 18 to 24 inches. Most areas of Guernsey soils are on the upper benches and ridgetops. Deep, plastic, dark-brown, limy Brooke soils occupy small areas on some of the rounded ridgetops and benches between the ridgetops. Deep, well drained Brookside and deep, moderately well drained Clarksburg soils occur at the foot of the hills next to the bottom lands. Deep Huntington, Lindside, and Melvin soils occupy the bottom lands. A few acres of deep Monongahela and Captina soils occur on the upper benches along Wheeling Creek.

This is the main farming area of the county. Dairying is the major type of farming. The more gentle slopes on the ridgetops are used to produce grain and hay. Farmers produce most of the hay needed for their livestock. The steeper slopes between the ridgetops and woodlands are used for pasture. The very steep valley walls are in woods.

Erosion on the farmed ridgetops and benches is moderate to severe. Much of the land on the ridgetops is farmed in contour strips. Soil slips are common on gentle slopes, particularly on those in pastures.

Hilly, rough soils formed on acid sandstone, acid shale, and calcareous red shale: Gilpin-Upshur.—This area is the roughest part of Marshall County. The ridgetops are narrower and the intervening slopes are steeper than in the Westmoreland area. Some of the steeper hills are broken by benches, apparently because the underlying rocks weathered at different rates. The valley walls along the Ohio River and Fish Creek are extremely sharp.

The dominant soils are the moderately deep, well-drained Gilpin soils and the deep to moderately deep, well-drained, reddish Upshur soils. These are mapped together as soil complexes. Gilpin soils are underlain by acid sandstone and shale, and the Upshur, by calcareous red shale. Both are on the uplands. Other soils on the uplands in this area are the Guernsey and Westmoreland.

The Brookside and Clarksburg occupy the lower slopes and are generally darker in this area than in the Westmoreland area. The Huntington, Lindside, and Melvin soils occupy the bottom land. Some deep Wyatt soils with a claypan, as well as some deep, windblown, droughty Lakin soils, occur near the mouth of Fish Creek. Remnants of old terrace soils occur almost to the head of Fish Creek.

Much of this area is in woods. About 7,000 acres having slopes of more than 30 percent is used for crops and pasture. The steep erodible soils are not suitable for intensive agriculture. Most of the farms are general farms. Grain and hay are grown for feeding livestock on the farm.

Erosion in this area is moderate to severe. Slips, bare spots, and gullies are common. In some places red shale



Figure 2.—Landscape in Westmoreland soil association showing typical land use: Woodland in drainageways, pasture on lower slopes, and cropland on ridgetops.

is exposed, and in others, gray shale or sandstone. A mixture of the two is exposed in some areas.

Hilly soils formed on interbedded, acid, gray shale and sandstone: Gilpin.—This area is not so steep as the sharp-ridged Gilpin-Upshur area but steeper than the Westmoreland area. It is mainly confined to the Grave Creek watershed east of Rosbys Rock. The valley walls of Grave Creek lack the gorgelike characteristics of those along Wheeling Creek, Fish Creek, and the Ohio River.

The characterizing soils of this area are the moderately deep, well-drained Gilpin. They are underlain by interbedded, acid, gray shale and sandstone. Scattered in this area are Westmoreland soils, Gilpin-Upshur soils, and the soils that normally occur with these. Soils of the bottom lands and colluvial lands are not extensive.

Many of the steep slopes have been cleared and are used for pasture. The gentle slopes on the ridgetops are used to produce grain and hay for feeding livestock on the farm. Most of the farms are general farms.

Erosion is moderate to severe because slopes have been cleared that are too steep for pasture or crops. Slips are not so common as in the Westmoreland and Gilpin-Upshur areas.

Nearly level soils on terraces and flood plains of the Ohio River: Wheeling-Huntington.—This is the nearly level terrace and bottom-land area along the Ohio River. Deep, well-drained Wheeling and Huntington are the dominant soils.

Nearly all of this area is used for towns and industrial sites.

Use, Management, and Estimated Yields

This section has three main parts. The first gives some principles of soil management that apply to all the soils in Marshall County.

The second part indicates the relative suitability of the soils for farming, grazing, forest, and wildlife. In this part, the soils are placed in capability units; that is, groups of soils that need similar management.

The third part provides estimated yields of principal crops under two levels of management: the management ordinarily practiced and the improved management that most farmers in the county would find practical to follow.

General Principles of Management

Some general principles and practices of management apply to all the soils of Marshall County.

1. Use a soil within its capabilities, and treat it according to its needs.
2. Control erosion. Most soils in Marshall County will erode if improperly managed. It is difficult and expensive to rebuild badly eroded land.

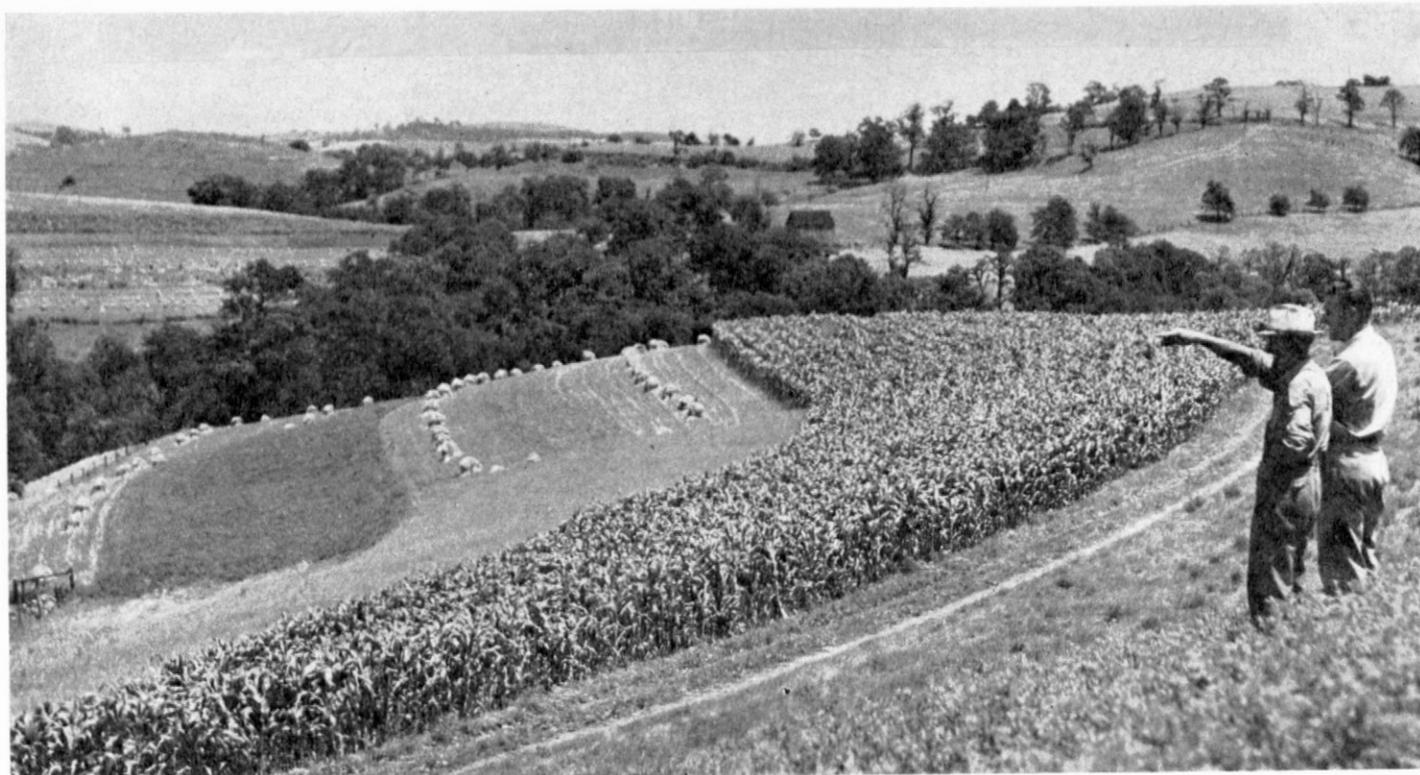


Figure 3.—Stripcropping near Glen Easton.

3. Rotate crops to improve tilth, reduce runoff, and increase moisture-holding capacity. Even the most productive soil needs an occasional hay crop.
4. Contour stripcrop (fig. 3) on all slopes used for rotation crops. On a Westmoreland soil of 12 percent slope, 300 feet long, for example, the soil loss is about 20 tons per acre per year when a rotation of corn, wheat, and hay is used and cultivation is up and down the slope. By contour stripcropping, this loss can be cut to about 4 tons per acre per year.
5. Apply lime and fertilizer. All the soils in the county respond to them, and it costs about as much to produce a poor crop as a good one. The amount of fertilizer and lime needed depends on the kind of soil, the crops to be grown, and past management. Base the application on soil tests. The county agent or a local representative of the Soil Conservation Service can explain how to take soil tests and advise on amounts of lime and fertilizer to apply. Phosphorus is deficient in nearly all of the soils in Marshall County. Potassium is generally low in the nearly level and gently sloping soils, particularly in the sandy and light silty soils. All the soils are low in nitrogen, unless legumes have been grown on them regularly and manure has been used abundantly. Boron is deficient in some soils for certain crops. Some level sandy and highly leached soils need boron if alfalfa is grown. To maintain the desired pH, lime should be applied about every 5 to 7 years.
6. Select the best varieties of row crops, grasses, and legumes and plant them on the kind of soil they need to make their best growth.
7. Follow row crops with a cover crop. The cover crop protects the soil from erosion and improves tilth.
8. Apply manure, one of the best soil builders, where it is needed most—to cropland, to eroded spots, or to pastures.
9. Do not overgraze pastures or turn the animals in before the soil is firm in spring. Take into account the fact that tall grasses produce more forage than bluegrass and other short grasses.

Capability Groups of Soils

Capability grouping is a system of classification used to show the relative suitability of soils for crops, grazing, forestry, and wildlife. It is a practical grouping based on the needs and limitations of the soils, the risks of damage to them, and also their response to management. There are three levels above the soil mapping unit in this grouping. They are the capability unit, subclass, and class.

The capability unit, which can also be called a management group of soils, is the lowest level of capability grouping. A capability unit is made up of soils similar in kind of management they need, in risk of damage, and in general suitability for use.

The next broader grouping, the subclass, is used to indicate the dominant kind of limitation. The letter symbol "e" indicates that the main limiting factor is risk of erosion if the plant cover is not maintained; "w" means excess water that retards plant growth or interferes with cultivation; "s" shows that the soils are shallow, droughty, or unusually low in fertility. In some parts of the country there is another subclass "c" for the soils that are limited chiefly by a climate that is too cold or too dry.

The broadest grouping, the land capability class, is identified by Roman numerals. All the soils in one class have limitations and management problems of about the same degree, but of different kinds, as shown by the subclass. All the land classes except class I may have one or more subclasses.

In classes I, II, and III are soils that are suitable for annual or periodic cultivation of annual or short-lived crops.

Class I soils are those that have the widest range of use and the least risk of damage. They are level, or nearly level, productive, well drained, and easy to work. They can be cultivated with almost no risk of erosion and will remain productive if managed with normal care.

Class II soils can be cultivated regularly but do not have quite so wide a range of suitability as class I soils. Some class II soils are gently sloping; consequently, they need moderate care to prevent erosion. Other soils in class II may be slightly droughty, slightly wet, or somewhat limited in depth.

Class III soils can be cropped regularly but have a narrower range of use. These need even more careful management.

In class IV are soils that have greater natural limitations than those in class III, but they can be cultivated for some crops under very careful management.

In classes V, VI, and VII are soils that normally should not be cultivated for annual or short-lived crops, but they can be used for pasture or range, for woodland, or for wildlife.

Class V soils are nearly level and gently sloping but are droughty, wet, low in fertility, or otherwise unsuitable for cultivation. No class V soils were mapped in this county.

Class VI soils are not suitable for crops, because they are steep, or droughty, or otherwise limited, but they are suitable for pasture or forest products. Some soils in class VI can, without damage, be cultivated enough so that fruit trees or forest trees can be planted or pasture crops seeded.

Class VII soils are restricted in use largely to grazing or forest products and have characteristics that limit them severely for these uses.

In class VIII are soils that have practically no agricultural use. Some of them have value as watersheds, as wildlife habitats, or for scenery. There are no class VIII soils shown in Marshall County.

CLASSES, SUBCLASSES, AND UNITS IN MARSHALL COUNTY

The soils of Marshall County have been grouped in the following capability classes, subclasses, and units:

Class I.—Nearly level, productive soils that are very good for crops and other uses and have few limitations.

Unit I-4.—Deep, well-drained silt loams and sandy loams on terraces underlain by sand and gravel.

Unit I-6.—Deep, well-drained, nearly level, fertile soils on bottom land.

Class II.—Soils that have some limitations that reduce the choice of plants or require some conservation practices.

Subclass IIe.—Soils subject to moderate erosion.

Unit IIe-4.—Deep, well-drained, gently sloping soils.

Unit IIe-6.—Deep, well-drained, gently sloping, bottom-land soils.

Unit IIe-10.—Gently sloping, moderately deep, acid, upland soils.

Unit IIe-11.—Gently sloping, lime-influenced, upland and colluvial soils.

Unit IIe-13.—Gently sloping, moderately well drained, acid siltpan soils.

Unit IIe-14.—Gently sloping, lime-influenced soils that have a claypan or siltpan at 18 to 24 inches.

Unit IIe-15.—Gently sloping, moderately deep, mixed red and lighter colored soils.

Subclass IIw.—Soils moderately limited by excess water.

Unit IIw-7.—Deep, medium-textured, moderately well drained to somewhat poorly drained, bottom-land soils.

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

Subclass IIIe.—Soils subject to moderate and severe erosion.

Unit IIIe-4.—Gently to moderately sloping, deep, medium-textured soils on alluvial terraces.

Unit IIIe-10.—Moderately sloping, moderately deep, brown or yellowish-brown, acid soils on uplands.

Unit IIIe-11.—Gently to moderately sloping, lime-influenced, upland and colluvial soils.

Unit IIIe-13.—Gently to moderately sloping, moderately well drained, acid siltpan soils on alluvial terraces.

Unit IIIe-14.—Gently to moderately sloping, lime-influenced claypan soils.

Unit IIIe-15.—Moderately sloping, moderately deep, mixed brown or yellowish-brown and red soils.

Unit IIIe-30.—Dark-brown, plastic, limestone soils.

Subclass IIIw.—Soils limited by excess water.

Unit IIIw-1.—Deep, poorly drained, dark-brown or gray, bottom-land soils.

Unit IIIw-5.—Deep, lime-influenced, claypan soils on terraces.

Class IV.—Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.

Subclass IVe.—Soils subject to severe erosion.

Unit IVe-1.—Moderately sloping to steep, well-drained, lime-influenced soils.

Unit IVe-3.—Moderately sloping to steep, well-drained, acid soils.

Unit IVe-5.—Moderately sloping, deep, excessively drained, windblown soils.

Unit IVe-9.—Moderately steep to steep, moderately well drained, lime-influenced claypan soils.

Unit IVe-15.—Moderately sloping to steep, moderately deep, mixed red and light-colored soils.

Subclass IVw.—Wet clayey soils.

Unit IVw-3.—Poorly drained, gray-colored soils.

Class VI.—Soils that have severe limitations which make them generally unsuited to cultivation and limit their use largely to permanent cover.

Subclass VIe.—Soils subject to very severe erosion.

Unit VIe-1.—Moderately sloping to steep, claypan terrace soils.

Unit VIe-3.—Moderately steep to steep, upland and colluvial soils.

Class VII.—Soils unsuited to cultivation that have very severe limitations.

Subclass VIIe.—Soils subject to very severe erosion.

Unit VIIe-1.—Steep to very steep, moderately deep, lime-influenced upland soils.

Unit VIIe-2.—Steep to very steep, moderately deep, acid upland soils.

TABLE 5.—Approximate acreage in various uses and total acreage of the capability classes, subclasses, and units

Capability class, subclass, and unit	Cropland ¹	Pasture	Forest	Idle	Miscellaneous ²	Total
	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>
Class I, total.....	3, 624	1, 128	283	468	369	5, 872
I-4.....	180	9	0	47	76	312
I-6.....	3, 444	1, 119	283	421	293	5, 560
Class II, total.....	1, 995	1, 755	283	438	244	4, 715
Subclass IIe, total.....	1, 474	1, 120	131	363	244	3, 332
IIe-4.....	292	207	28	205	113	845
IIe-6.....	95			19	28	142
IIe-10.....	95	94		9		198
IIe-11.....	645	397	38	56	47	1, 183
IIe-13.....	151	283	47	55	28	564
IIe-14.....	111	92	9		28	240
IIe-15.....	85	47	9	19		160
Subclass IIw:.....						
IIw-7.....	521	635	152	75		1, 383
Class III, total.....	10, 180	7, 417	994	569	557	19, 717
Subclass IIIe, total.....	10, 076	7, 208	985	467	529	19, 265
IIIe-4.....	142	189	38	103	9	481
IIIe-10.....	665	541	38	28	9	1, 281
IIIe-11.....	7, 665	4, 596	522	243	408	13, 434
IIIe-13.....	19	117	27	9	27	199
IIIe-14.....	161	359	94	47		661
IIIe-15.....	1, 311	1, 292	266	37	76	2, 982
IIIe-30.....	113	114				227
Subclass IIIw, total.....	104	209	9	102	28	452
IIIw-1.....	95	161	9	102	28	395
IIIw-5.....	9	48				57
Class IV, total.....	13, 584	21, 657	3, 270	726	339	39, 576
Subclass IVe, total.....	13, 547	21, 643	3, 261	707	339	39, 497
IVe-1.....	8, 934	15, 164	1, 898	391	236	26, 623
IVe-3.....	968	1, 489	133	55	9	2, 654
IVe-5.....	9	9	9	65		92
IVe-9.....	131	613	159			903
IVe-15.....	3, 505	4, 368	1, 062	196	94	9, 225
Subclass IVw:.....						
IVw-3.....	37	14	9	19		79
Class VI, total.....	4, 242	26, 200	8, 374	548	189	39, 553
Subclass VIe:.....						
VIe-1.....		47	9			56
VIe-3.....	4, 242	26, 153	8, 365	548	189	39, 497
Class VII, total.....	1, 192	12, 617	66, 096	196	102	80, 203
Subclass VIIe:.....						
VIIe-1.....	700	8, 298	64, 359	187	93	73, 637
VIIe-2.....	497	4, 319	1, 732	9	9	6, 566
Totals.....	34, 817	70, 774	79, 300	2, 945	1, 800	189, 636
Unclassified, total.....		38	75	157	5, 934	6, 204
Made Land.....		38	75	120	2, 392	2, 625
Mine Dumps.....				37	152	189
Miscellaneous.....					3, 390	3, 390

¹ Includes acreage in long-term hay.² Includes farmsteads, urban developments, and other miscellaneous areas.

Table 5 shows the acreage of each capability class, subclass, and unit in each of the present land uses in Marshall County.

Capability units

The soils of Marshall County have been placed in 29 capability units. The soils in a given unit have about the same limitations and risks of damage, need about the same management, and respond to that management in about the same way.

Each capability unit is identified by a symbol; for example, IVe-3. The class is indicated by the Roman numeral, the subclass by the small letter, and the unit by an Arabic number. These Arabic numbers are assigned in a statewide system. The numbering of the units is not

consecutive in this county, because some of the capability units recognized in West Virginia do not occur in this county.

CAPABILITY UNIT I-4

Deep, well-drained silt loams and sandy loams on terraces underlain by sand and gravel

These nearly level soils of capability unit I-4 are easy to work and moderately productive. Any of the crops grown in the county can be produced on these soils. Yields may be somewhat reduced on the sandy loam during dry years. For maximum production, fertilizer and lime should be applied according to needs determined by soil tests and the requirements of the crops grown. The pH should be checked, and the organic-matter con-

tent, which is very low in Wheeling sandy loam, 0 to 3 percent slopes, should be maintained. The soils in this unit are:

Wheeling silt loam, 0 to 3 percent slopes (W₀).

Wheeling sandy loam, 0 to 3 percent slopes (W_m).

Cropland.—These soils can be used for row crops continuously if fertilizer and lime are applied as needed and the organic-matter content is maintained. Crop residues should be worked into the soil to maintain organic matter and good tilth. Rye, ryegrass, or some other cover crop should be used in winter to protect the soil.

Long-term hay.—A mixture of alfalfa with timothy, orchardgrass, or bromegrass is good for long-term hay. Clover will not last more than 1 or 2 years. The fields should be topdressed every year with a fertilizer high in phosphate and potash, such as 0-20-20, and should be reseeded before the legume runs out.

Pasture.—Well-managed, well-fertilized, tall-grass pasture will produce more forage than permanent native bluegrass on these soils. On all pasture, lime should be applied in sufficient quantity to maintain a pH of about 6.5. These soils tend to be low in potassium and respond well to an annual topdressing made up of equal parts of phosphate and potash. Tall-grass pasture should be divided into fields and the livestock rotated from field to field. All pasture should be clipped to control weeds and rank growth.

CAPABILITY UNIT I-6

Deep, well-drained, nearly level, fertile soils on bottom land

The soils of capability unit I-6 are medium acid. They are flooded occasionally, particularly in the lower lying areas.

Any crops grown in the county are suited to these soils, but for maximum production, apply fertilizer and lime according to the needs of the crop grown. The soils require slightly different management because they have different texture. Huntington fine sandy loam, 0 to 3 percent slopes, is somewhat droughty. It needs lime about every 4 years and is low in content of organic matter. If Huntington silty clay loam, 0 to 3 percent slopes, is to be kept in good tilth, plowing should be avoided when the soil is wet, and an abundant supply of organic matter should be maintained. The soils in this unit are:

Ashton silt loam, 0 to 3 percent slopes (A₀).

Huntington silty clay loam, 0 to 3 percent slopes (H_f).

Huntington fine sandy loam, 0 to 3 percent slopes (H_d).

Huntington silt loam, 0 to 3 percent slopes (H_e).

Cropland.—These soils can be used for row crops almost continuously if fertilizer and lime are applied as needed and the organic-matter content is maintained. To improve tilth and organic-matter content, crop residues should be worked into the soils. In winter, the soils should be protected with cover crops such as rye, wheat, ryegrass, or vetch. Small wet areas should be drained.

Long-term hay.—Alfalfa-grass mixtures produce high yields if properly treated. For maximum production, meadows should be topdressed every year with a phosphate-potash fertilizer and reseeded before the legumes run out.

Pasture.—Ladino clover-grass mixtures do especially well on the silt loam and silty clay loam soils in this unit. A tall-grass pasture is better than native bluegrass-white-clover pasture. All permanent pasture should be limed to maintain a pH of about 6.5. A tall-grass pasture should be topdressed every year with a phosphate-potash fertilizer. Tall-grass pasture should be divided into fields and the livestock rotated from field to field. Clip all pasture, as needed, to control weeds and rank growth.

CAPABILITY UNIT IIe-4

Deep, well-drained, gently sloping soils

The soils of capability unit IIe-4 are acid throughout the profile. The hazard of erosion is moderate. The soils of this unit warm early in spring and are easy to work.

Any of the crops grown in the county are suited to the soils of this unit. Liming to correct the natural acidity of the soils and fertilizing according to the needs of the crop are essential for good production. Wheeling sandy loam, 3 to 10 percent slopes, needs to be limed more often than the silt loam soils in this unit. All the soils in unit IIe-4, particularly Wheeling sandy loam, need additions of organic matter to maintain good tilth and to increase capacity to hold water that plants can use. The soils in this unit are:

Holston silt loam, 2 to 8 percent slopes (H₀).

Wheeling sandy loam, 3 to 10 percent slopes (W_n).

Wheeling silt loam, 3 to 10 percent slopes (W_p).

Cropland.—Use of a rotation that includes at least 1 year of hay in 3 years will help to maintain good tilth and control erosion on these soils. Farming should be on the contour, and natural waterways should be kept in sod. Crop residues worked into the soil will improve the organic-matter content. These soils need a winter cover crop, such as rye or wheat, following a row crop.

Long-term hay.—Any legume-grass mixture does well on these soils. Alfalfa, together with timothy, orchardgrass, or bromegrass, is good for long-term hay. Clovers will not last more than 2 years. Meadows should be topdressed every year with a high phosphate-potash fertilizer, such as 0-20-20. Plowing should be in contour strips when these soils are reseeded. Waterways should be kept in natural sod.

Pasture.—Tall-grass pasture produces more grazing than permanent native bluegrass pasture. It is used most efficiently if grazing is rotated. All pasture needs lime to maintain a pH of about 6.5 and should be topdressed with a phosphate-potash fertilizer. The response to fertilizer is excellent. Pasture also needs clipping to control weeds and rank growth.

CAPABILITY UNIT IIe-6

Deep, well-drained, gently sloping, bottom-land soils

This unit consists of only one soil. It is medium acid and normally is not flooded.

Small grain, row crops, hay, or pasture produce high yields on this soil if fertilizer and lime needs are met. The sandy areas are droughty and low in organic-matter content. The soil of this unit is:

Ashton silt loam, 3 to 12 percent slopes (A_b).

Cropland.—A rotation using hay 1 year in 3 will help control erosion. It should include a winter cover crop. Contour cultivation and natural waterways in sod are sometimes needed to control erosion. All crop residue should be plowed or disked in to improve tilth and help maintain organic-matter content.

Long-term hay.—Alfalfa-grass mixtures produce high yields if properly treated. This soil should be topdressed every year with a phosphate-potash fertilizer and reseeded before the legume runs out. Plowing should be on the contour when meadows are reseeded.

Pasture.—Any commonly used grass-legume mixture is suited to this soil. Ladino clover and orchardgrass are good. Tall-grass pasture will usually outyield the native bluegrass-whiteclover pasture. Permanent pasture should be limed to maintain a pH of about 6.5. Tall-grass pasture should be topdressed every year, and permanent bluegrass pasture every 4 years, with a phosphate-potash fertilizer. For the most efficient use of tall-grass pasture, divide it into fields and move the livestock from field to field. All pasture should be clipped to control weeds and rank growth.

CAPABILITY UNIT IIe-10

Gently sloping, moderately deep, acid, upland soils

Only one soil is in this unit. It is well drained and overlies acid sandstone and shale at about 30 inches. Its natural fertility is below average for the soils in the county. However, it holds moisture well and responds readily to lime and fertilizer. The soil in this capability unit is:

Gilpin silt loam, 3 to 10 percent slopes (Gc).

Cropland.—The most intensive suitable rotation consists of a row crop, a small grain, and 1 year of hay. Contour cultivation on the short slopes and contour stripcropping on the long slopes will reduce runoff. Natural draws should be left in sod. Following row crops, a winter cover crop, such as rye, wheat, or vetch, should be grown to protect the soil. Crop litter, worked into the surface soil, will maintain good tilth and increase organic matter. Lime, applied according to needs indicated by soil tests, will correct the natural acidity of the soil. Adequate fertilizer is essential for good production.

Long-term hay.—A mixture of alfalfa with timothy, orchardgrass, or bromegrass does well on this soil if lime and fertilizer needs are met. Most legume-grass mixtures do well if the sod is properly treated. Before the legume runs out, the soil should be reseeded. Seed in contour strips, or on the contour without strips if a trashy mulch method of seedbed preparation is used. Meadows should be topdressed with a phosphate-potash fertilizer every year for maximum production.

Pasture.—This soil is fairly good for pasture. Well-managed, well-fertilized, tall-grass pasture will produce more grazing than permanent pasture made up of native bluegrass and whiteclover. Normally the bluegrass pasture is at a standstill during July and August because of a lack of moisture. Grazing should be rotated on tall-grass pasture to give the plants time to recover. Apply lime and fertilizer, as needed, to keep the pasture productive. All pasture should be clipped to control weeds and rank growth.

CAPABILITY UNIT IIe-11

Gently sloping, lime-influenced, upland and colluvial soils

Soils in this unit range from moderately deep to deep. They are well drained and hold moisture well. Slips and deep gullies may occur on these soils if they are not properly used and managed.

If these soils are adequately fertilized, all crops grown in the county grow well on them. Alfalfa is exceptionally well suited. The soils in this unit are:

Westmoreland silt loam, 3 to 10 percent slopes (Wc).

Brookside silt loam, 3 to 8 percent slopes (Bc).

Cropland.—The most intensive rotation recommended on these soils consists of a row crop, a small grain, and 1 year of hay. To keep these soils productive, a rotation including 2 or more years of an alfalfa-grass mixture should be followed. A winter cover crop, such as rye, wheat, or vetch, should follow row crops. Cultivation on the contour, stripcropping, and proper use of crop rotations will help to maintain good tilth and organic-matter content and to control runoff. Diversion ditches are sometimes needed to break long slopes. Natural draws should be left in sod. Lime and fertilizer, applied in amounts determined by soil tests, are necessary for maximum production.

Long-term hay.—If the soils are properly managed, a mixture of alfalfa with timothy, orchardgrass, or bromegrass will produce high yields. Clovers do well but last only a short time. To keep yields high, reseeded should be done before the legume runs out. The trashy mulch method of seedbed preparation on these sloping soils helps to maintain organic-matter content and to reduce runoff. Contour strips should be used if the soil is plowed before reseeded. Meadows should be topdressed every year with a phosphate-potash fertilizer.

Pasture.—Any grass-legume mixture suited to the county makes good pasture on these soils. However, tall-grass pasture provides more grazing than the native bluegrass-whiteclover pasture. The permanent bluegrass-whiteclover pasture is almost at a standstill in July and August because of lack of moisture. Tall-grass pasture should be divided into fields and the livestock rotated from field to field. Overgrazing and grazing early in spring and late in fall make these soils subject to erosion. During these periods, the soil is soft and the sod is easily damaged by trampling. Permanent pasture should be limed to maintain a pH of about 6.5. All pasture should be clipped to control weeds and rank growth.

CAPABILITY UNIT IIe-13

Gently sloping, moderately well drained, acid siltpan soils

Only one soil is in this unit. It is a deep terrace soil. A siltpan occurs at depths of 18 to 24 inches. Water builds up on top of the pan during wet periods and causes poor aeration. Erosion is moderate. An occasional springlike seep spot and a few small, somewhat poorly drained areas need artificial drainage. The soil is acid throughout and probably is the most leached soil in the county. It is very low in potash and in organic-matter content. It will produce all the crops grown in the county, but deep-rooted legumes such as alfalfa do not

last so long as on well-drained soils. The soil in this unit is:

Monongahela silt loam, 2 to 8 percent slopes (Md).

Cropland.—A 3-year rotation that includes at least 1 year of hay will help control erosion and keep the soil productive. A winter cover crop following row crops is needed to protect the soil. By working crop litter into the surface, good tilth will be maintained and the organic-matter content increased. Runoff can be reduced by using contour cultivation and stripcropping. Natural draws should be left in sod. The amounts of lime and fertilizer applied should be determined by soil tests and the needs of the crop grown.

Long-term hay.—If the soil is properly managed, a mixture of alfalfa, orchardgrass, alsike clover, red clover, and ladino clover grows well. Ladino clover is desirable in the mixture if the meadow is to be used for after-math grazing or if the soil has wet spots. In places it is necessary to reseed meadows more often on this soil than on well-drained soils. The trashy mulch method of seed-bed preparation will reduce runoff. Use of contour strips is desirable if the meadow is reseeded by plowing. Enough lime to maintain a pH of about 6.5 and a complete fertilizer should be applied at time of seeding. For maximum production, topdress every year with a phosphate-potash fertilizer.

Pasture.—This soil is capable of producing good pasture. The grass-legume mixture used for long-term hay makes good pasture. Tall-grass pasture produces more grazing than a permanent pasture of bluegrass. The native bluegrass will not take over areas that have been seeded to tall-grass pasture as rapidly on this soil as on most of the lime-influenced upland-soils. All permanent pasture should receive sufficient lime to maintain a pH of 6.5. Additions of phosphate and potash are necessary. Pasture should be clipped, as needed, to control weeds and rank growth. Rotate grazing on the tall-grass pasture.

CAPABILITY UNIT He-14

Gently sloping, lime-influenced soils that have a claypan or siltpan at 18 to 24 inches

These soils occur on benches and broad ridgetops on the upland and at the base of steep hillsides. Because water moves very slowly through the pan layer, they are only moderately well drained. The soils in this unit are:

Clarksburg silt loam, 3 to 8 percent slopes (Cb).

Guernsey silt loam, 3 to 10 percent slopes (Gx).

Captina silt loam, 3 to 8 percent slopes (Ca).

Cropland.—A 3-year rotation that consists of a row crop, a small grain, and 1 year of hay is the most intensive that should be used on these soils. A winter cover crop should follow a row crop to protect the soil. Erosion can be checked by working as much crop litter into the surface soil as possible. Use of contour cultivation, and stripcropping where possible, will reduce runoff. In places, a diversion ditch is needed to intercept water from adjacent hills. Natural draws should be left as sod waterways. An occasional seep spot may need artificial drainage. For top production of all crops, lime and fertilizer should be applied according to needs determined by soil tests.

Long-term hay.—Most grasses and legumes can be produced satisfactorily on these soils. Ladino clover should be included in the mixture if the meadow is used for after-math grazing. Deep-rooted legumes, such as alfalfa, may not last as long on these soils as on well-drained soils, but they are recommended and should be used. When the legume runs out, these soils should be reseeded. Reseeding by the trashy mulch method helps control erosion. If these soils are plowed before reseeding, contour strips should be used where possible. Meadows should be limed to maintain a pH of 6.5 and fertilized every year with phosphate and potash.

Pasture.—These soils hold moisture well and are capable of producing good pasture throughout the grazing season. There are fewer problems if the soils are used for pasture than if used for cultivated crops. This is particularly true of the colluvial soils that occur at the base of the hilly land.

The soils of this unit occur in narrow bands and contain ravines, hummocks, and seep spots. As a result they are difficult to use for crops or hay. Bluegrass and whiteclover provide good grazing throughout the grazing season if rainfall is normal. Tall-grass pasture also produces well on these soils. Alfalfa, red clover, ladino clover, alsike clover, orchardgrass, and brome grass are some of the legumes and grasses commonly used. All permanent pasture should be limed to maintain a pH of about 6.5 and fertilized according to needs shown by soil tests. Rotate grazing on the tall-grass pasture. All pasture should be clipped to control weeds.

CAPABILITY UNIT He-15

Gently sloping, moderately deep, mixed red and lighter colored soils

The soils in this unit are underlain by red shale, gray shale, and sandstone. They are well drained, although their clayey subsoils absorb water slowly. These soils are fairly high in potassium but very low in phosphorus. The risk of erosion increases greatly when they are intensively cultivated. Areas of these soils developed from red clay shale are difficult to work. Only one mapping unit is in this group:

Gilpin-Upshur silty clay loams, 3 to 10 percent slopes (Gk).

Cropland.—For top production, apply lime and fertilizer according to needs indicated by soil tests. The most intensive rotation suitable for the soils of this unit consists of a row crop, a small grain, and 1 year of hay. A longer rotation helps keep the soils productive. A winter cover crop following a row crop will protect the soil. Runoff can be reduced on these soils by using contour cultivation on the short slopes and stripcropping and diversion ditches on the long slopes. Disking crop residue into the soils will also reduce runoff as well as improve tilth and help control erosion. Natural draws should be left as sod waterways.

Long-term hay.—These soils are suited to any of the grasses and legumes grown in the county. Alfalfa and orchardgrass are a good mixture. Ladino clover should be added if the meadow is grazed. Reseeding should be done before the legume runs out. If possible the trashy mulch method should be used to build organic matter and reduce runoff. If the reseeding requires plowing, contour strips are needed. Good yields will be produced if the soil is

limed enough to bring the pH to 6.5, and fertilizer is applied according to needs determined by tests. Meadows should be topdressed every year with a fertilizer high in phosphate but containing some potash, such as 0-14-7.

Pasture.—These are good pasture soils. Tall grasses, native bluegrass, and whiteclover grow well on them. Grazing should be carefully controlled early in spring and late in fall. Much damage can result from livestock trampling when these soils are wet and soft. Rotational grazing should be used on tall-grass pasture. Both tall-grass and native bluegrass-whiteclover pastures should be given enough lime to bring the pH to 6.5 and should be fertilized according to needs determined by soil tests. All pasture should be clipped to control weeds and rank growth.

CAPABILITY UNIT IIw-7

Deep, medium-textured, moderately well drained to somewhat poorly drained, bottom-land soils

Only one soil is in this capability unit. Its use is limited by flooding and a wet lower subsoil. During spring and winter, the lower part of the subsoil is often full of water and poorly aerated. Many areas of this soil are flooded 2 or 3 times a year; others are flooded only once in 4 or 5 years. The soil in this unit has a high natural fertility. Most crops commonly grown in the county can be produced without artificial drainage. However, the wetter areas must be artificially drained to produce the best possible yields. The soil in this unit is:

Lindside silt loam, 0 to 3 percent slopes (lb).

Cropland.—A rotation that includes at least 1 year of hay every 3 years should be used. Crops start more slowly on this soil than on well-drained, bottom-land soils and are occasionally damaged by floods. Those that will stand some seasonal wetness should be selected. The amount of lime and fertilizer applied should be determined by soil tests and the needs of the crop grown.

Pasture.—This is a good pasture soil. It holds moisture well throughout the growing season. Well-managed pastures of tall grass-legume mixtures or native bluegrass produce good grazing. A mixture such as ladino clover-orchardgrass is well suited. Rotational grazing should be used on tall-grass pasture. Grazing should be delayed on all pasture until the soil becomes firm. Pasture should receive enough lime to maintain a pH of about 6.5 and should be topdressed with a phosphate-potash fertilizer. All pasture should be clipped to control weeds and rank growth.

CAPABILITY UNIT IIIe-4

Gently to moderately sloping, deep, medium-textured soils on alluvial terraces

This unit contains only one soil. Maintenance of organic matter is important in controlling erosion. Unless limed, the soil is acid throughout the profile. It is normally low in potassium. The soil is:

Holston silt loam, 8 to 15 percent slopes (Hb).

Cropland.—A 4-year rotation that includes 2 years of hay should be used on this soil. Farming should be in contour strips, and natural waterways should be kept in sod.

Long-term hay.—All hay mixtures do well on this soil if lime and fertilizer needs are met. Alfalfa lasts longer

than clover in a grass-legume mixture. Meadows should be topdressed every year with a high phosphate-potash fertilizer, such as 0-20-20. The soil should be reseeded before the legume runs out. Plowing should be in contour strips. Waterways should be left in natural sod.

Pasture.—If properly managed, this soil produces more grazing on tall-grass pasture than on permanent bluegrass pasture. Use of rotational grazing on the tall-grass pasture is desirable. All pasture should be limed to maintain a pH of about 6.5 and topdressed with a fertilizer high in phosphate and potash. All pasture should be clipped to control weeds and rank growth.

CAPABILITY UNIT IIIe-10

Moderately sloping, moderately deep, brown or yellowish-brown, acid soils on uplands

There is only one soil in this unit. It is well drained and is underlain by acid sandstone and shale at about 30 inches. It holds moisture well and is easy to work if the supply of organic matter is maintained.

Any crops grown in the county can be grown on this soil. Its natural fertility is below average for the county, but response to lime and fertilizer is good. Serious sheet and rill erosion occur unless runoff is controlled. The soil in this unit is:

Gilpin silt loam, 10 to 20 percent slopes (Gb).

Cropland.—The shortest rotation that can be successfully used to control erosion consists of a row crop, a small grain, and 2 or more years of hay. Use of contour cultivation on the short slopes and contour strips on the long slopes will reduce runoff. Natural draws should be left in sod. The soil needs a winter cover crop, such as rye, wheat, or vetch, following row crops. Good tillth can be maintained and the supply of organic matter increased by working crop litter into the surface soil. Lime in amounts determined by soil tests should be applied to correct the natural acidity of the soil. Adequate fertilizer is needed to produce good yields.

Long-term hay.—A mixture of alfalfa with timothy, orchardgrass, or bromegrass does well on this soil. Most legume-grass mixtures grow well if the sod is properly treated. The soil should be reseeded before the legume runs out. Seed either in contour strips or on the contour without strips if the trashy mulch method of seedbed preparation is used. Meadows should be topdressed with a phosphate-potash fertilizer every year for top production.

Pasture.—This is a fairly good pasture soil. Well-managed, well-fertilized tall-grass pasture will produce more grazing than permanent bluegrass-whiteclover pasture. Normally the bluegrass pasture is at a standstill during July and August because of lack of moisture. Grazing should be rotated on tall-grass pasture to give the plants time to recover. Apply lime and fertilizer to maintain the productivity of the pasture. All pasture should be clipped to control weeds and rank growth.

CAPABILITY UNIT IIIe-11

Gently to moderately sloping, lime-influenced, upland and colluvial soils

Capability unit IIIe-11 consists of moderately deep soils on the uplands (Westmoreland) and deep soils on the

lower slopes of the uplands (Brookside). These soils are well drained. They hold moisture well. Unless runoff is controlled, serious sheet and rill erosion will result. Slips and deep gullies occur if these soils are not properly used and managed.

All crops grown in the county can be grown on these soils. Alfalfa does exceptionally well. Although the soils of this unit are above average in natural fertility, they need lime and fertilizer to produce good yields. The soils in this unit are:

Westmoreland silt loam, 10 to 20 percent slopes (Wb).

Brookside silt loam, 8 to 15 percent slopes (Bd).

Cropland.—These soils make up nearly one-fourth of the cropland in Marshall County. To maintain production, they need a rotation that includes 2 or more years of an alfalfa-grass mixture. A winter cover crop, such as rye, wheat, or vetch, should follow row crops. Good tilth and a good supply of organic matter should be maintained. Runoff should be controlled by using contour cultivation, stripcropping, and proper crop rotations. In places, diversion ditches are needed to break long slopes. Natural draws should be left in sod to serve as sod waterways. To get top production, lime and fertilizer should be applied according to needs determined by soil tests.

Long-term hay.—A mixture of alfalfa with timothy, orchardgrass, or bromegrass will produce high yields if properly managed. Clovers do well but last only a short time. To maintain high yields, reseed before the legume runs out. The trashy mulch method of seedbed preparation on these sloping soils helps to reduce runoff. If reseeded is by plowing, contour strips are needed. Meadows should be topdressed every year with a phosphate-potash fertilizer.

Pasture.—Any grass-legume mixtures suited to the other soils of the county produce good pasture on these soils. However, tall-grass pasture provides more grazing than the permanent bluegrass-whiteclover pasture, which is almost at a standstill in July and August because of lack of moisture. Tall-grass pasture should be divided into fields and the livestock rotated from field to field. Grazing should be carefully regulated during early spring and late fall because the soil is soft and the sod is easily damaged by trampling. Early spring and late fall grazing, as well as overgrazing, make the soil subject to erosion. All permanent pasture should receive enough lime to maintain a pH of about 6.5. Fertilizer should be applied according to needs shown by soil tests. Pasture requires clipping to control weeds and rank growth.

CAPABILITY UNIT IIIe-13

Gently to moderately sloping, moderately well drained, acid siltpan soils on alluvial terraces

Only one soil is in this capability unit. The siltpan in this soil occurs at depths of 18 to 24 inches and impedes drainage and restricts aeration.

This soil is subject to erosion if intensively cultivated. Alfalfa does not last as long as on well-drained soils. The soil in this unit is:

Monongahela silt loam, 8 to 15 percent slopes (Me).

Cropland.—The most intensive suitable rotation includes at least 2 years of hay. This soil should be protected

by a winter cover crop following a row crop. Crop litter, worked into the surface soil, will help maintain good tilth and increase the supply of organic matter. Amounts of lime and fertilizer should be determined by soil tests and by the needs of the crop grown. Runoff will be reduced by using contour cultivation and stripcropping. Natural draws should be left in sod to serve as waterways.

Long-term hay.—If properly managed, a hay crop that consists of a mixture of alfalfa, orchardgrass, alsike clover, red clover, and ladino clover does well on this soil. The ladino clover in the mixture is desirable if the meadow is to be used for aftermath grazing or if the soil has wet spots. Sometimes it is necessary to reseed meadows more often than on well-drained soils. The trashy mulch method of seedbed preparation will increase the supply of organic matter and reduce runoff. If reseeded is by plowing, contour strips are necessary. Enough lime should be applied to maintain a pH of about 6.5. A complete fertilizer should be used at time of seeding. For top production, topdress every year with a phosphate-potash fertilizer.

Pasture.—These soils can be made to produce good pasture. The grass-legume mixture used for long-term hay is suited to pasture. Tall-grass pasture produces more grazing than permanent bluegrass pasture. Native bluegrass will not take over areas that have been seeded to tall-grass pasture as rapidly on this soil as it does on most of the lime-influenced upland soils. Permanent pasture should be limed to maintain a pH of 6.5. All pasture needs additions of phosphate and potash. Use of rotational grazing is desirable on the tall-grass pasture. Pasture should be clipped to control weeds and rank growth.

CAPABILITY UNIT IIIe-14

Gently to moderately sloping, lime-influenced claypan soils

These are moderately deep to deep, moderately well drained soils. They occur on upland and colluvial areas at the base of steep hillsides. The depth to the claypan is 15 to 24 inches. Water moves very slowly through the pan and collects on top of it in prolonged wet periods. Numerous natural drains and draws dissect many areas of the colluvial soils in this unit and make such practices as stripcropping difficult if not impossible. The surface, in many places, has a hummocky appearance as a result of soil slips. Erosion is moderate.

The soils in unit IIIe-14 are above average in natural fertility. All crops grown in the county can be produced on these soils. Deep-rooted legumes, such as alfalfa, do not last as long as on well-drained soils. Because of the location of these soils, diversion ditches are often needed to cut off the water from the hillsides. The soils in this unit are:

Clarksburg silt loam, 8 to 15 percent slopes (Cc).

Guernsey silt loam, 10 to 20 percent slopes (Gy).

Cropland.—A 4-year rotation that includes at least 2 years of hay is suitable for these soils. A winter cover crop following the row crop will protect the soil. For top production on these soils, apply lime and fertilizer according to needs determined by soil tests. As much crop residue as possible should be worked into the surface to check erosion. Use of contour cultivation and stripcropping where possible will reduce runoff. Diversion ditches to

intercept water from adjacent hills should be constructed where needed. Natural draws should be left as sod waterways.

Long-term hay.—Most grasses and legumes can be produced satisfactorily on these soils. Ladino clover should be included in the mixture if the meadow is used for aftermath grazing. Deep-rooted legumes do not last as long on these soils as on well-drained soils, but they should be grown. Reseeding is necessary when the legume runs out. Reseeding by the trashy mulch method helps control erosion. Contour strips should be used where possible, if reseeding is by plowing. Meadows need enough lime to maintain a pH of 6.5 and should be fertilized every year with phosphate and potash.

Pasture.—These soils hold moisture well and are capable of producing good pasture throughout the grazing season. Management problems are lessened if the soils are used for pasture rather than for crops, particularly the colluvial soils at the base of the hillsides. The narrowness of the soil areas, as well as ravines, hummocks, and seep spots, cause many problems if these soils are used for cultivated crops or hay. Bluegrass and whiteclover provide good grazing throughout the grazing season if rainfall is normal. Tall-grass pasture also produces well on these soils. Alfalfa, red clover, ladino clover, alsike clover, orchardgrass, and brome grass are some of the legumes and grasses commonly used. All permanent pasture should be limed to maintain a pH of about 6.5 and fertilized according to the needs shown by soil tests. Rotational grazing should be used on tall-grass pasture. All pastures should be clipped, as needed, to control weeds.

CAPABILITY UNIT IIIe-15

Moderately sloping, moderately deep, mixed brown or yellowish-brown and red soils

The soils of this unit are well drained. They are underlain by red shale, gray shale, and sandstone. They are rather clayey in the subsoil and absorb water slowly. Erosion is moderate, but serious sheet and rill erosion, as well as deep gullies and slips, will occur unless runoff is controlled by conservation practices and good soil management.

The soils in this unit have average or above average natural fertility. However, they need lime and fertilizer to produce good yields of the crops grown. They are fairly high in potassium but very low in phosphorus. Any crops grown in the county can be grown on these soils, but, because of the risk of erosion, grasses and legumes are preferred. The soils developed from red clay shale are difficult to work. The mapping unit in this group is:

Gilpin-Upshur silty clay loams, 10 to 20 percent slopes (Gm).

Cropland.—A 4-year rotation that includes at least 2 years of hay is suitable. A longer rotation will help keep the soils productive. Applications of lime and fertilizer according to needs shown by soil tests are necessary to obtain maximum production. Runoff can be reduced by using contour cultivation on the short slopes and strip-cropping and diversion ditches on the long slopes. A winter cover crop should follow a row crop to protect the soil.

Long-term hay.—These soils are suited to any of the grasses and legumes grown in the county. A good mixture consists of alfalfa and orchardgrass. Ladino clover should be added to the mixture if the meadow is to be grazed. Reseeding should be done before the legume runs out. If possible, reseed by the trashy mulch method to reduce runoff and erosion. If reseeding is by plowing, contour strips are necessary. Good yields will be produced if the soil is given enough lime to maintain a pH of 6.5 and fertilizer is applied according to needs determined by soil tests. Meadows should be topdressed every year with a fertilizer that is high in phosphate but contains some potash.

Pasture.—These are good pasture soils. Both tall-grass and native bluegrass-whiteclover pastures do well on them. Grazing should be carefully regulated early in spring and late in fall. Much damage can result if livestock trample these soils when they are wet and soft. Rotational grazing is desirable on the tall-grass pasture. Enough lime should be applied to maintain a pH of 6.5. Fertilizer should be applied according to the needs shown by soil tests, both for tall-grass pasture and for permanent bluegrass-whiteclover pasture. All pasture should be clipped to control weeds and rank growth.

CAPABILITY UNIT IIIe-30

Dark-brown, plastic, limestone soils

Only one soil is in this capability unit. It is a deep, well-drained upland soil. It holds moisture well and has high natural fertility. This soil is fine textured and consequently takes in water slowly. Serious sheet and rill erosion result unless contour cultivation and strip-cropping are used to reduce runoff. This soil occurs in small areas and is generally used with the surrounding soils in units IIe-11 and IIIe-11.

This soil produces good yields of all grasses and legumes. It is heavy and difficult to plow and becomes very firm and cracks during dry periods. The soil in this unit is:

Brooke silty clay loam, 8 to 20 percent slopes (Ba).

Cropland.—Although this soil is high in natural fertility, it needs lime and adequate fertilizer for maximum production. A 4-year rotation that includes 2 years of an alfalfa-grass mixture is suitable. Proper crop rotations are needed to control erosion. Winter cover crops following row crops will protect the soil. The tilth will improve and runoff decrease if a good supply of organic matter is maintained.

Long-term hay.—A mixture of alfalfa with timothy, orchardgrass, or brome grass produces high yields on these soils if fertilizer and lime requirements are met. A top-dressing of phosphate-potash fertilizer is needed every year to get best yields. Reseeding should be done before the legume runs out. If reseeding is by plowing, contour strips should be used.

Pasture.—This is about the best upland pasture soil in the county. Both tall grass-legume mixtures and native bluegrass are well suited. Permanent pasture should be limed to maintain a pH of about 6.5 and fertilized according to needs shown by soil tests. Grazing should be delayed until the soil and sod are firm. All pasture should be clipped to control weeds and rank growth.

CAPABILITY UNIT IIIw-1

Deep, poorly drained, dark-brown or gray, bottom-land soils

Only one soil is in this capability unit. It is subject to frequent flooding, and during wet periods water stands on the surface, particularly in depressionlike areas. In its natural state, this soil is too wet for anything but a poor grade of pasture. If it is drained and the drainage system is maintained, the soil is suitable for crop rotations. The natural fertility is high. The soil in this unit is:

Melvin silt loam, 0 to 3 percent slopes (Mb).

Cropland.—A 4-year rotation that includes at least 2 years of hay is suitable. Crops grown should be able to withstand some wetness. Clovers, particularly ladino, are better suited to these soils than deep-rooted legumes such as alfalfa. Lime and fertilizer should be applied according to needs shown by soil tests. Before the soil is cropped, a drainage system should be installed, either open ditches or tile. The soil becomes cloddy if worked when wet. Intensive cropping soon destroys the soil structure and leads to the development of a plowpan. Thus, the effectiveness of the tile system is reduced.

Hay or pasture.—These soils are capable of producing good yields of hay or pasture. Only rarely, however, can desirable species of grasses and legumes be grown without artificial drainage. Open drains are economical and usually satisfactory if the soil is used for hay or pasture. This soil stays moist throughout the growing season. Mixtures of reed canarygrass and ladino clover do well if the soil is properly limed and fertilized. Bluegrass and white-clover also do well when the soil is properly managed and treated. Pasture should not be grazed until the soil is reasonably firm.

CAPABILITY UNIT IIIw-5

Deep, lime-influenced, claypan soils on terraces

Only one soil is in this capability unit. It is moderately well drained to somewhat poorly drained. Slopes are very gentle, but the soil is highly erodible. Because of poor aeration in the dense claypan at about 18 inches, deep-rooted legumes do not last long. Water collects on the pan during winter and delays the warming of this soil until late in the spring.

This soil is strongly acid to a depth of about 30 inches. Although it is lime influenced, lime and fertilizer are needed to produce satisfactory yields of crops. The surface soil is medium textured and not hard to work, but it is low in organic matter and becomes cloddy if worked when too wet. The soil in this unit is:

Wyatt silt loam, 3 to 8 percent slopes (Wr).

Cropland.—A rotation should include at least 2 years of hay in 4 years. For maximum production, adequate lime and fertilizer are needed. Surface drainage is required for the best production of row crops and small grains. Because of the heavy clay subsoil, tile is not recommended. Stripcropping on a slight grade will help control erosion without holding too much surface water. Winter cover crops help prevent erosion and puddling of the surface soil.

Long-term hay and pasture.—Hay or pasture is more suitable for this soil than rotated crops. Permanent hay

and tall-grass pasture mixtures, such as ladino clover-orchardgrass, do well if the soil is properly limed and fertilized and a topdressing of a phosphate-potash fertilizer is applied every year. Reseeding should be done before the legume runs out. Permanent pasture should receive enough lime to maintain a pH of 6.0. This soil holds moisture well and supplies adequate grazing throughout the grazing season if properly managed. Livestock trampling damages the sod when the soil is not firm.

CAPABILITY UNIT IVe-1

Moderately sloping to steep, well-drained, lime-influenced soils

This capability unit consists of moderately deep upland soils and deep colluvial soils. These soils hold moisture well. If not protected, they erode. Some are severely eroded. Numerous gullies, slides, and slips are characteristic of the soils of this group.

These soils will produce all crops grown in the county. However, row crops should be grown only 1 year in every 4 or 5, since the soils are steep and subject to severe erosion. The soils of this unit are above average in natural fertility but need lime and fertilizer to produce good crop yields. They are excellent for growing alfalfa. The soils in this unit are:

Westmoreland silt loam, 10 to 20 percent slopes, severely eroded (Wc).

Westmoreland silt loam, 20 to 30 percent slopes (Wd).

Westmoreland silt loam, 20 to 30 percent slopes, severely eroded (We).

Brookside silt loam, 15 to 25 percent slopes (Be).

Brookside silt loam, 15 to 25 percent slopes, severely eroded (Bf).

Brooke silty clay loam, 20 to 40 percent slopes (Bb).

Long-term hay.—A long-lived, grass-legume mixture, such as alfalfa seeded with orchardgrass, brome grass, or timothy, is suitable for the soils of this unit. Some ladino clover should be added if the meadows are grazed. Reseeding should be by the trashy mulch method before the legume runs out. Tillage to prepare the seedbed should be on the contour. If these soils are reseeded by plowing, contour stripcropping is needed to reduce runoff. In places, diversion ditches are needed on long slopes to keep the water from concentrating in gullies. Natural waterways should be left in permanent sod. Meadows need to be topdressed annually with a phosphate-potash fertilizer and limed enough to maintain a pH of about 6.5.

Pasture.—Tall-grass mixtures produce good pasture on these soils. Ladino clover and orchardgrass do well. Birdsfoot trefoil is a promising legume. Native bluegrass pasture is well suited, but in July and August the production is low for native bluegrass-whiteclover pasture. Tall-grass pastures should be treated annually with a phosphate-potash fertilizer. Permanent bluegrass pasture should be topdressed every 3 or 4 years. Grazing should be avoided in spring until the soil becomes firm. Livestock should be taken off the pasture in the fall so the sod will be in good shape before winter. Overgrazing encourages erosion and should be avoided. All pasture should be clipped to control weeds and rank growth.

CAPABILITY UNIT IVe-3

Moderately sloping to steep, well-drained, acid soils

The soils in this unit consist of moderately deep Gilpin soils and the deep Holston soil. Erosion is both moderate and severe on these soils. The severely eroded areas have lost most of the original topsoil and contain slips and gullies.

These soils are acid throughout unless they have been limed. Because of slope and risk of erosion, they should be kept in grass most of the time. They should be tilled only when reseeded. The soils in this unit are:

- Gilpin silt loam, 20 to 30 percent slopes (Gc).
- Gilpin silt loam, 20 to 30 percent slopes, severely eroded (Gd).
- Holston silt loam, 15 to 25 percent slopes (Hc).

Long-term hay.—Any of the grasses and legumes grown in the county can be grown on these soils. Use of a long-lived, grass-legume mixture such as alfalfa and orchardgrass is desirable. Reseeding should be done by the trashy mulch method and the seedbed prepared on the contour. If reseeded is by plowing, contour strips are necessary. Natural draws should be left in permanent sod. For maximum production, topdress meadows annually with a phosphate-potash fertilizer, and apply enough lime to maintain a pH of about 6.5.

Pasture.—A tall-grass mixture of ladino clover and orchardgrass will furnish more grazing than native bluegrass-whiteclover pasture. These soils are not as well suited to native bluegrass pasture as the soils in capability units IVe-1 and IVe-15. All permanent pasture should be limed to maintain a pH of about 6.5. Tall-grass pasture should be topdressed annually and bluegrass pasture every 4 years. Livestock should not graze in spring until the soil becomes firm. They should be taken off the pasture in fall so that the sod will be in good shape before winter. Overgrazing should be avoided. Pasture needs clipping to control weeds and rank growth.

CAPABILITY UNIT IVe-5

Moderately sloping, deep, excessively drained, wind-blown soils

Only one soil is in this capability unit. It is a sandy, open soil low in natural fertility. Fair yields of hay can be obtained if the soil is fertilized annually and limed every 4 years and its supply of organic matter is built up. A mixture of alfalfa with orchardgrass or brome grass is suited. The soil in this unit is:

- Lakin loamy sand, 10 to 20 percent slopes (Lc).

Cropland.—This soil is best suited to early vegetables and small fruits. Heavy applications of manure and fertilizer and the use of cover crops are needed to obtain high yields.

CAPABILITY UNIT IVe-9

Moderately steep to steep, moderately well drained, lime-influenced claypan soils

The soils of this capability unit hold moisture well. The claypan occurs 18 to 24 inches below the surface. During the winter water collects above it. Because of the poor drainage in the subsoil, deep-rooted legumes, such as alfalfa, do not last as long on these soils as on well-drained soils. These soils should be kept in grass most of

the time because of their strong slope and the risk of erosion. They should be tilled only when reseeded is needed. The soils in this unit are:

- Clarksburg silt loam, 15 to 25 percent slopes (Cd).
- Clarksburg silt loam, 15 to 25 percent slopes, severely eroded (Ce).
- Guernsey silt loam, 20 to 30 percent slopes, severely eroded (Gz).

Long-term hay.—A mixture of alfalfa, orchardgrass, alsike clover, red clover, and ladino clover does well on these soils. A mixture of orchardgrass and ladino clover is equally well suited, and the stand will probably last longer. Reseeding should be done by the trashy mulch method. If reseeded is by plowing, contour strip cropping is necessary. In places, diversion ditches are needed to keep surface water from concentrating in gullies. Natural draws should be left in sod for waterways. Enough lime should be used to maintain a pH of about 6.5. An annual topdressing of phosphate-potash fertilizer is needed.

Pasture.—Native bluegrass and whiteclover or a mixture of ladino clover and orchardgrass produces good grazing on these soils. Normally these soils have plenty of moisture throughout the grazing season. All permanent pasture should be limed enough to maintain a pH of about 6.5. Tall-grass pasture should be topdressed every year, and the permanent native bluegrass pasture every 3 or 4 years. Grazing should be delayed in spring until the soil becomes firm. Overgrazing should be avoided, and livestock should be taken off the pasture to allow the sod to grow well before winter. Pasture should be clipped to control weeds and rank growth.

CAPABILITY UNIT IVe-15

Moderately sloping to steep, moderately deep, mixed red and light-colored soils

The soils of this capability unit are underlain by layers of red shale, gray shale, and sandstone. They are well drained. They have a fairly clayey subsoil and absorb moisture slowly. They hold moisture well. These soils have about average natural fertility and are generally fairly high in potassium and low in phosphorus.

Erosion on some soils is severe. Slips, gullies, and bare spots are numerous. Gullies and other severely eroded areas should be sloped, fertilized at about double the normal rate, and mulched and seeded. Some of the very severely eroded areas should be retired to woods. The areas of these soils underlain by red clay shale are very erodible. Because of the strong slopes and erosion hazard, these soils should be kept in grass most of the time and tilled only when reseeded is needed. The soils in this unit are:

- Gilpin-Upshur silty clay loams, 10 to 20 percent slopes, severely eroded (Gn).
- Gilpin-Upshur silty clay loams, 20 to 30 percent slopes (Go).
- Gilpin-Upshur silty clay loams, 20 to 30 percent slopes, severely eroded (Gp).

Long-term hay.—These soils are suited to any of the grasses and legumes grown in the county. A hay crop that consists of a mixture of alfalfa with orchardgrass, brome grass, or timothy lasts a long time if the soils are properly managed. Reseeding should be done before the

legume runs out. The trashy mulch method of reseeded will reduce runoff. If reseeded is by plowing, contour strips are necessary. In places, diversion ditches are needed for long slopes to keep the water from concentrating in gullies. Natural waterways should be kept in permanent sod. Meadows should be limed enough to maintain a pH of about 6.5 and should be topdressed annually. A fertilizer test may indicate that only phosphate is needed.

Pasture.—These are good pasture soils. Both tall-grass mixtures and permanent native bluegrass produce good grazing if the soils are properly managed. Ladino clover and orchardgrass make a good tall-grass mixture. These soils are naturally suited to native bluegrass and white-clover. All permanent pasture should receive enough lime to maintain a pH of about 6.5. Tall-grass pasture should be topdressed every year and bluegrass-whiteclover pasture every 3 or 4 years. Grazing early in the spring and late in fall should be carefully regulated. During these periods, the soil is soft and the sod is easily damaged by trampling. Grazing when the soil is wet and overgrazing encourage erosion and should be avoided. All pasture needs clipping to control weeds and rank growth.

CAPABILITY UNIT IVw-3

Poorly drained, gray-colored soils

Only one soil is in this capability unit. It is a deep terrace soil that occurs mostly along Wheeling Creek in association with soils of the Captina series. The tight clayey subsoil causes slow movement of water and poor aeration.

Grasses and legumes that can withstand wetness are best suited to this soil, but generally they can be grown satisfactorily only if the surface is drained. If the soil is limed, fertilized, and drained, a row or grain crop can be grown occasionally. The soil in this unit is:

Robertsville silt loam, 0 to 5 percent slopes (Rc).

Long-term hay or pasture.—Some type of artificial drainage should be installed before attempting to grow desirable grasses and legumes. Because of the tight subsoil, best results are usually obtained by using open ditches. A seed mixture of ladino clover-reed canarygrass does well. If a row crop is grown, the soil should not be worked when wet. Enough lime should be applied to maintain a pH of about 6.5. Applications of a high phosphate-potash fertilizer should be made annually.

Because this soil holds moisture well, adequately limed and fertilized natural bluegrass-whiteclover pasture produces well throughout the grazing season. Livestock trampling damages the drainage ditches and the sod when the soil is not firm. Therefore, the grazing must be carefully managed.

CAPABILITY UNIT VIc-1

Moderately sloping to steep, claypan terrace soils

Only one soil is in this capability unit. It is deep, is influenced by lime, and has a tight claypan at about 20 inches. It occurs as narrow bands on steep breaks. Because of the strong slopes and possible erosion hazard, it should be kept in permanent pasture or woods.

The soil in this unit is:

Wyatt silt loam, 15 to 30 percent slopes (Ws).

Pasture.—This soil is difficult to lime, fertilize, and mow. However, pastures of native bluegrass and white-clover produce fair grazing if the soil is limed enough to maintain a pH of 6.0 and is topdressed every 4 years with a phosphate fertilizer. Overgrazing and grazing early in spring before the soil is firm should be avoided.

Woodland.—Land-use adjustments may permit most areas of this soil to be used for woodland. For classification for woodlands, see the section Use and Management of Woodlands.

CAPABILITY UNIT VIc-3

Moderately steep to steep, upland and colluvial soils

The soils in this unit are well drained. Some have severe erosion. Because of steep slopes and the risk of erosion, these soils should be kept in permanent pasture or woods. Slopes of 30 to 40 percent are difficult to lime, fertilize, and mow. Satisfactory permanent pastures can be produced on these soils. Areas not needed for pasture, however, should be retired to woods. The soils in this unit are:

Westmoreland silt loam, 30 to 40 percent slopes (Wf).

Westmoreland silt loam, 30 to 40 percent slopes, severely eroded (Wg).

Gilpin-Upshur silty clay loams, 30 to 40 percent slopes (Gs).

Gilpin-Upshur silty clay loams, 30 to 40 percent slopes, severely eroded (Gt).

Gilpin-Upshur silty clay loams, 20 to 30 percent slopes, very severely eroded (Gr).

Brookside silt loam, 25 to 35 percent slopes (Bg).

Brookside silt loam, 25 to 35 percent slopes, severely eroded (Bh).

Pasture.—Pastures should be given enough lime to maintain a pH of 6.0. In addition, they should be topdressed with high-analysis phosphate every 4 years. Normally the pasture on these soils is almost at a standstill for about 6 weeks in July and August. Supplemental pasture from other soil areas is necessary during this time. Grazing early in spring, before the soil is firm, damages the sod and helps cause slips and gullies. Overgrazing results in excessive runoff and serious erosion. Gullies and other severely eroded areas should be sloped if necessary, fertilized heavily, seeded, mulched, and protected from grazing. Water should be provided for the livestock in large fields in order to distribute grazing and prevent too much trampling and grazing around one spring or water source. Pasture should be clipped to control weeds.

Woodland.—About one-fifth of the area in this unit is in woods. Land-use adjustments should permit more areas to be restored to woodland. For classification for woodlands, see the section Use and Management of Woodlands.

CAPABILITY UNIT VIIc-1

Steep to very steep, moderately deep, lime-influenced upland soils

On the soils of this capability unit, erosion ranges from slight to very severe.

These soils should be used for woodland because of their steep slope and the risk of erosion. About 87 percent of their total area is now in woodland. The productivity of these soils for wood products varies. It depends largely on the location on the slope and the direction of exposure. The inherent fertility and the moisture supply are favorable for the production of good timber. The soils in this unit are:

- Westmoreland silt loam, 40 to 55 percent slopes (W_h).
 Westmoreland silt loam, 40 to 55 percent slopes, severely eroded (W_k).
 Gilpin-Upshur silty clay loams, 30 to 40 percent slopes, very severely eroded (G_u).
 Gilpin-Upshur silty clay loams, 40 to 55 percent slopes (G_v).
 Gilpin-Upshur silty clay loams, 40 to 55 percent slopes, severely eroded (G_w).

For information on woodlands, see the section Use and Management of Woodlands.

CAPABILITY UNIT VIIe-2

Steep to very steep, moderately deep, acid upland soils

On the soils of this unit, erosion ranges from slight to severe. Because of the steep slopes and consequent erosion hazard, these soils should be used for permanent woodland. The soils are:

- Gilpin silt loam, 30 to 40 percent slopes (G_e).
 Gilpin silt loam, 30 to 40 percent slopes, severely eroded (G_f).
 Gilpin silt loam, 40 to 55 percent slopes (G_g).
 Gilpin silt loam, 40 to 55 percent slopes, severely eroded (G_h).

For information on woodlands, see the section Use and Management of Woodlands.

Estimated Yields of Principal Crops ²

The estimated average acre yields of the principal crops for the soils of Marshall County are given in table 6. These yields are obtained under two levels of management.

In columns A are estimated yields for crops grown under common practices now being used in the county. In preparing these estimates, average yields from 1950 and 1954 census reports and West Virginia Experiment Station Bulletin No. 280 on pastures (2) were used as a base. The yields on the different soils are estimated in relation to these averages. Soil characteristics, observation of the quality of crops, and yields obtained from experimental work in other parts of the State were all considered.

Estimated yields in columns B are those that can be obtained under the best management practicable. They are based on yields obtained by some farmers in the area and on knowledge of the properties of the soils and their ability to respond to good management. The best management, or optimum management, includes not only the meeting of lime and fertility requirements but other applicable practices such as good rotations, erosion control, and drainage where needed. Irrigation is not considered in these predictions, since this practice is still relatively unusual in this area.

Comparisons of yields in columns B with those in columns A will show the response to be expected under improved, or optimum, management. Some soils respond better to management than others. The soils that show the best response are deep and have a good texture and moisture-holding capacity. The yields of soils with relatively high natural fertility tend to be high in columns A, but the ability of these soils to respond to optimum management may be limited by poor physical properties.

² G. G. POHLMAN, West Virginia Agricultural Experiment Station, assisted in the preparation of this section of the report.

The increase in yields under improved management is greater from hay and pasture than from corn. This is because, under common management, corn and small grain are better managed than hay and pasture. There is still a tendency to look on pasture as a natural product of the soil and to neglect the fertility and other management practices needed to produce good yields.

Use and Management of Woodlands ³

Present Woodlands

Approximately 40 percent of Marshall County is wooded. Nearly half of the wooded acreage is in farm woodlots, which average about 30 acres per farm. The rest is in larger, privately owned tracts. There is no State or National forest in Marshall County. Woodlands are scattered throughout the county, but the larger tracts are in the southern half in the Gilpin and Gilpin-Upshur soil areas. The slopes are steeper there, and farmers have retained more of their land in forest. Most woodlands are on the steep lower slopes and on both sides of the streams and drainageways. A large area occurs on the very steep bluff facing the Ohio River.

Woodlands in Marshall County show the results of abuse and neglect. Heavy cutting and continuous grazing have depleted growing stock of the better species. "High-grading" has continually removed the best and left the worst. Culls and low-value species have accumulated and occupy valuable growing space on excellent woodland soils. Low-value white elm, cull beech, and poorly formed black cherry now occupy thousands of acres where once oak, sugar maple, and yellow-poplar grew. A long time will be needed to make such woodlands productive again. Restoration of good woodland soil conditions and the gradual return of the oaks are necessary. The simplest woodland conservation practices can, in time, bring this about. Protection from grazing, the killing of culls, and the removal and utilization of low-value species, such as white elm, will help increase woodland productivity.

Because of the poor condition of Marshall County woodlands, timber is not an important source of income. Most of the wood cut now is for such products as mine props and fenceposts. Some farmers cut a truckload or two of logs and have them sawed at the nearest sawmill into lumber for home use. Buyers of veneer-grade timber still find small tracts of walnut, poplar, and oak, but such trees are increasingly hard to find.

Natural Reforestation and Replanting

Approximately 14,000 acres of class VII land in Marshall County should be used for woodland. Most of this land is now in steep, eroded, low-grade pasture.

It is estimated that about 5,000 acres of this land may reforest naturally with acceptable species if protected from grazing. About 9,000 acres will need to be reforested by planting. Otherwise, only hawthorn, elm, sassafras, hickory, and other low-grade trees and shrubs will cover the land.

³ ROSS H. MELLINGER, woodland conservationist, Soil Conservation Service, assisted in the preparation of this section of the report.

TABLE 6.—*Estimated average acre yields of principal crops*

[Yields in columns A obtained under common management; those in columns B obtained under optimum management (see text for definition of management at common and optimum levels); absence of yield figure indicates that the crop is not recommended]

Soil	Corn (county average, 45 bushels)		Alfalfa-grass (county average, 1.9 tons)		Permanent pasture (county average, 60 cow-acre-days)	
	A	B	A	B	A	B
Ashton silt loam, 0 to 3 percent slopes	Bu. 75	Bu. 110	Tons 2.7	Tons 4.3	Cow-acre-days ¹ 90	Cow-acre-days ¹ 180
Ashton silt loam, 3 to 12 percent slopes	65	95	2.5	3.8	80	175
Brooke silty clay loam, 8 to 20 percent slopes	55	90	2.3	3.6	70	150
Brooke silty clay loam, 20 to 40 percent slopes			1.9	3.5	65	140
Brookside silt loam, 3 to 8 percent slopes			2.5	3.6	80	170
Brookside silt loam, 8 to 15 percent slopes	55	90	2.3	3.5	75	165
Brookside silt loam, 15 to 25 percent slopes	50	85	2.5	3.3	70	160
Brookside silt loam, 15 to 25 percent slopes, severely eroded			1.7	3.0	50	140
Brookside silt loam, 25 to 35 percent slopes					65	150
Brookside silt loam, 25 to 35 percent slopes, severely eroded					45	135
Captina silt loam, 3 to 8 percent slopes	50	85	1.9	3.0	80	170
Clarksburg silt loam, 3 to 8 percent slopes	50	85	1.8	3.0	80	175
Clarksburg silt loam, 8 to 15 percent slopes	48	80	1.6	2.8	75	170
Clarksburg silt loam, 15 to 25 percent slopes			1.4	2.6	65	160
Clarksburg silt loam, 15 to 25 percent slopes, severely eroded			1.2	2.4	60	155
Gilpin silt loam, 3 to 10 percent slopes	45	85	1.7	3.5	60	145
Gilpin silt loam, 10 to 20 percent slopes	40	80	1.5	3.3	55	140
Gilpin silt loam, 20 to 30 percent slopes			1.3	3.1	50	135
Gilpin silt loam, 20 to 30 percent slopes, severely eroded			1.1	2.9	45	120
Gilpin silt loam, 30 to 40 percent slopes					30	90
Gilpin silt loam, 30 to 40 percent slopes, severely eroded						
Gilpin silt loam, 40 to 55 percent slopes						
Gilpin silt loam, 40 to 55 percent slopes, severely eroded						
Gilpin-Upshur silty clay loams, 3 to 10 percent slopes	50	90	2.1	3.7	70	160
Gilpin-Upshur silty clay loams, 10 to 20 percent slopes	45	85	1.8	3.5	60	150
Gilpin-Upshur silty clay loams, 10 to 20 percent slopes, severely eroded			1.6	3.3	50	145
Gilpin-Upshur silty clay loams, 20 to 30 percent slopes			1.8	3.5	55	150
Gilpin-Upshur silty clay loams, 20 to 30 percent slopes, severely eroded			1.4	3.0	45	140
Gilpin-Upshur silty clay loams, 20 to 30 percent slopes, very severely eroded						
Gilpin-Upshur silty clay loams, 30 to 40 percent slopes					40	100
Gilpin-Upshur silty clay loams, 30 to 40 percent slopes, severely eroded						
Gilpin-Upshur silty clay loams, 30 to 40 percent slopes, very severely eroded						
Gilpin-Upshur silty clay loams, 40 to 55 percent slopes						
Gilpin-Upshur silty clay loams, 40 to 55 percent slopes, severely eroded						
Guernsey silt loam, 3 to 10 percent slopes	50	85	1.8	3.0	80	175
Guernsey silt loam, 10 to 20 percent slopes	48	80	1.6	2.8	75	170
Guernsey silt loam, 20 to 30 percent slopes, severely eroded			1.4	2.6	65	160
Holston silt loam, 2 to 8 percent slopes	45	85	1.8	3.5	65	160
Holston silt loam, 8 to 15 percent slopes	40	80	1.6	3.3	60	155
Holston silt loam, 15 to 25 percent slopes			1.5	3.1	55	150
Huntington fine sandy loam, 0 to 3 percent slopes	65	90	2.5	3.8	70	14
Huntington silt loam, 0 to 3 percent slopes	70	100	2.6	4.0	85	175
Huntington silty clay loam, 0 to 3 percent slopes	70	100	2.6	4.0	90	180
Lakin loamy sand, 10 to 20 percent slopes	30	50	1.5	2.0	30	50
Lindside silt loam, 0 to 3 percent slopes	50	90	1.7	3.0	80	165
Melvin silt loam, 0 to 3 percent slopes	30	75			70	140
Monongahela silt loam, 2 to 8 percent slopes	40	80	1.7	3.0	50	130
Monongahela silt loam, 8 to 15 percent slopes	35	70	1.5	2.7	40	120
Robertsville silt loam, 0 to 5 percent slopes	30	75			80	165
Westmoreland silt loam, 3 to 10 percent slopes	50	90	2.2	3.5	70	150
Westmoreland silt loam, 10 to 20 percent slopes	48	85	2.1	3.3	65	145
Westmoreland silt loam, 10 to 20 percent slopes, severely eroded			1.6	2.7	55	135
Westmoreland silt loam, 20 to 30 percent slopes			1.8	3.0	60	140
Westmoreland silt loam, 20 to 30 percent slopes, severely eroded			1.6	2.7	50	130
Westmoreland silt loam, 30 to 40 percent slopes					45	125
Westmoreland silt loam, 30 to 40 percent slopes, severely eroded						
Westmoreland silt loam, 40 to 55 percent slopes						
Westmoreland silt loam, 40 to 55 percent slopes, severely eroded						
Wheeling sandy loam, 0 to 3 percent slopes	50	85	2.1	3.2	40	90
Wheeling sandy loam, 3 to 10 percent slopes	45	80	1.9	3.0	35	80
Wheeling silt loam, 0 to 3 percent slopes	60	100	2.3	3.7	60	140
Wheeling silt loam, 3 to 10 percent slopes	55	95	2.1	3.5	55	130
Wyatt silt loam, 3 to 8 percent slopes	30	70	1.5	2.7	60	140
Wyatt silt loam, 15 to 30 percent slopes			1.3	2.5	55	130

¹ Cow-acre-days refers to the number of days in a year a mature animal (cow, horse, or steer) can graze an acre without injury to the pasture.

Some successful natural seeding is now taking place in woodland areas (fig. 4). Yellow-poplar volunteers on the best sites where there are enough seed trees and the areas are protected from grazing (fig. 5).

Most of the naturally established tree cover consists of black locust, white elm, and black cherry. The elm is much more numerous in the western half of the county. The elm-cherry stands are useful as a protective cover but are low in economic value. The black locust is of low quality except on the very best sites or where mixed with other hardwoods. It is a good soil-improving, pioneer species. Given protection and time enough, the locust stands will eventually give way to oak, ash, maple, and poplar.

The original timber growth in Marshall County consisted almost entirely of hardwoods. White pine and hemlock were found only on the cooler slopes and hollows along some of the streams. Remnants of these species are still there.

In tree planting, original timber growth is a poor guide for choosing species to plant. Planting sites have deteriorated because of cropping, pasturing, and erosion to the point where conifers are needed for successful establishment. Mice and rabbits have also proven to be serious hazards in establishing hardwoods, especially in old fields where there is relatively heavy sod. Many hardwoods are suitable on only the very best sites, and then only if cover conditions indicate low rodent populations.

The trees suitable for planting on each site will be found in the discussion of the site classes.

Forest Types (4)

Marshall County lies in the central hardwoods forest region. Several different forest types occur in the wooded areas. In general, forest types vary with sites.

Yellow-poplar-white oak-northern red oak type.—This forest type occurs in coves, on colluvial soils, and on lower slopes of residual soils where soil moisture is good and soils are deep. It occupies F_1 and F_2 sites (table 7). Associated species are white ash, black walnut, sugar maple, basswood, beech, and American elm. Some stands of yellow-poplar have resulted from natural seeding of old fields or cleared areas. Many acres of these sites are now growing only elm and cull beech. In the northern part of the county, sugar maple and beech make up a large part of these stands. Some areas are large enough to be recognized as a separate forest type (beech-sugar maple type).

White oak-red oak-hickory type.—This forest type occurs where supplies of soil moisture are average. It occupies F_3 sites (table 7). It is made up of several species of oak, but white oak and red oak predominate. A large part of the stand consists of black oak and shellbark, pignut, and mockernut hickories. Blackgum, red maple, beech, and some American elm are associated with this type.

White oak type.—This forest type occurs mostly on F_2 sites and on the better F_3 sites (table 7) where soil moisture is good. White, black, and red oaks predominate.

Figure 4.—*Top:* Area of Westmoreland silt loam (40 percent slope) on F_1 and F_2 sites, northern aspect. *Center:* Brush and natural tree seedlings are beginning to cover the same area a few years later because of natural reforestation. *Bottom:* Natural reforestation on same area 20 years later.





Figure 5.—Natural seeding of yellow-poplar on Clarksburg silt loam (10 percent slope), F₁ site, NE. aspect.

Associated species are yellow-poplar, hickory, white ash, red maple, sugar maple, beech, blackgum, and American elm.

Chestnut oak type.—This forest type occurs on slopes facing south and west and on dry ridgetops where soils are shallow and dry out quickly. It occupies F₃ and F₄ sites (table 7). Associated species are white, scarlet, and black oaks, hickory, and blackgum.

Black locust type.—Small, pure stands of this type occur throughout the county on abandoned fields and steep, rough areas that formerly were cultivated or pastured. This type occurs on sites F₂, F₃ and F₄. Many of the sites are severely eroded. Elm and black cherry are often associated with the trees of this site.

Productivity of Soils for Woodland

Soils differ greatly in productivity for woodland just as they do for other crops. The soil factors influencing tree growth are somewhat different from those influencing annual crops or pasture. Trees are a long-term crop and require decades to mature. Furthermore, the soil is not usually treated, or fertilized for the production of trees.

The capacity of the soil to supply moisture is important in growth of trees. The moisture-holding capacity of a soil is influenced by depth, texture, permeability, and internal drainage. The topographic position and direction of exposure (aspect) are also influencing factors. Other properties important in evaluating a soil for woodland use are slope, degree of erosion, acidity, and inherent fertility.

Some of the factors that influence woodland site and capability are discussed in the following paragraphs.

Aspect.—This is the compass direction toward which the slope faces. Tree growth studies show a definite relationship between aspect and the rate of growth (8). Trees grow better and soil moisture is better on north- and east-facing slopes than on those facing south and west. All of the factors involved in exposure are not known, but some that make south and west slopes poorer tree sites than the north and east slopes are evaporation of moisture because of prevailing winds, earlier melting snow, increased freezing and thawing, and differences in soil temperature. The topography of Marshall County makes aspect a most important factor in tree growth.

In the woodland soil-site classification, a true north-west-southeast line is established. Slopes facing north or east of this line are designated northeast slopes. Those facing south or west of the line are designated as southwest slopes.

Slope position.—Tree growth is influenced by position on the slope. It varies within upland soils on long slopes. The moisture supply of the soil changes with position on the slope. The underground water supply increases with increasing distance from the ridgetop. Usually, the total soil depth is greater on lower slopes than near the top, even within the same soil. Loss of soil moisture through evaporation and transpiration is less at the lower slope positions than near the ridgetops, which are more exposed to prevailing winds.

In classifying woodland sites that occur on long, steep hillsides, the slope is divided into three parts: (1) The upper; (2) the middle; and (3) the lower. The upper edge of the slope is the ridgetop or the point where the slope levels out to a broad, gently sloping ridgetop. The lower edge is at the stream or natural drainage channel, the outer edge of the flood plain, or the upper edge of a colluvial soil, such as Brookside or Clarksburg. The one-third position is obtained by arbitrarily dividing the slope into three equal parts.

Some soils have a characteristic position in the landscape. For example, the Holston and Wheeling are on terraces and the Huntington and Ashton are on bottom lands. Colluvial soils, such as the Clarksburg, always have the advantage of lower third positions.

Slope (steepness).—As slope increases, productivity of woodland soil decreases. Erosion hazards increase, runoff is greater, and infiltration decreases. Soils, even in the same series, tend to be shallower on steep slopes than on moderate slopes. In Marshall County, three broad slope ranges have been used in the classification of woodland sites: 0 to 20 percent slopes, 20 to 40 percent slopes, and slopes greater than 40 percent.

Erosion.—Severe erosion reduces the total depth of soil available for moisture storage. It also causes increased runoff and lower water intake. Natural reproduction of trees is affected adversely by severe erosion. In the classification of soil sites, severely eroded or very severely eroded areas are increased one class, thus F₂ becomes F₃.

Soil reaction and soil fertility.—Both reaction and fertility have some influence on the suitability of different species of trees to a soil. For example, black locust and black walnut do best on lime-influenced soils, such as Westmoreland, Brooke, and Gilpin-Upshur. Timber

buyers sometimes report less defect in trees grown on limestone soils. However, soil reaction and soil fertility are less important in Marshall County than the factors that directly influence moisture supply.

Site Classes

The soil types of Marshall County have been placed in four woodland site classes according to their ability to produce trees. Their expected productivity was determined through use of the oak-site index. This index is based on the average height of a normal stand of oak when it is 50 years old. Foresters using this index can determine the volume of timber that normal stands will produce at different ages. These four classes (F₁, F₂, F₃, and F₄) are discussed in this section.

Table 7 will help in estimating the site class for any tract of land in the county, providing the soil, the slope position (upper, middle, or lower third, if applicable), and the aspect are known. As stated earlier in this section, slopes facing north or east of a true northwest-southeast line are designated as northeast (NE.) slopes. Those facing south or west of this line are designated as southwest (SW.) slopes.

Suppose an area of Gilpin silt loam, 20 to 30 percent slopes, lies on the upper third of a long slope facing north. Find Gilpin silt loam in the first column of the table. In the second column find the slope position (upper-third)

and read across to the column that has the 20 to 40 percent slope range and a northeast exposure. Thus, the estimated site class of Gilpin silt loam, 20 to 30 percent slopes, is F₂. The procedure is the same for severely eroded soils, but one site class must be added to the class indicated in the table. Thus, the site class of Gilpin silt loam, 20 to 30 percent slopes; severely eroded, with the same slope position and same direction of exposure, is F₃.

F₁—Excellent.—This class consists of sites that are excellent for woodland use. These sites can produce high yields of good-quality forest. Hardwoods of fine quality, suitable for veneer logs, cooperage, and other specialty uses, can be grown. Intensive management practices are justified on F₁ sites. Short cutting cycles, permanent roads through the woods, thinning, and other improvement measures can be economically feasible. Location and care of logging roads present a few special problems. Because most of these areas are near streams, care should be taken to locate roads away from streambeds. Erosion and stream pollution can be reduced by (1) constructing roads in good locations and on grades of less than 10 percent, (2) bridging streams, (3) diverting water, and (4) seeding after logging. About 20 percent of the present woodland acreage of Marshall County is in this site class.

These moist site locations grow excellent trees of the more demanding species, such as yellow-poplar, black walnut, and red oak. The oaks usually make up a smaller component part of the stand on F₁ sites than on the other sites.

TABLE 7.—Key to woodland sites

Uneroded soil type ¹	Slope position	Slope range and aspect					
		0 to 20 percent		20 to 40 percent		40+ percent	
		NE.	SW.	NE.	SW.	NE.	SW.
Holston silt loam.....	} (2).....	All sites.....	F ₁				
Wheeling silt loam.....							
Wheeling sandy loam.....							
Brookside silt loam.....	} (2).....	F ₁	F ₁	F ₁	F ₂		
Clarksburg silt loam.....							
Wyatt silt loam.....	} (2).....	F ₁	F ₂	F ₂	F ₃		
Guernsey silt loam.....							
Captina silt loam.....							
Monongahela silt loam.....							
Gilpin silt loam.....	Lower third.....	F ₁	F ₂	F ₁	F ₂	F ₁	F ₃
	Middle third.....	F ₁	F ₂	F ₂	F ₃	F ₂	F ₃
	Upper third.....	F ₂	F ₃	F ₂	F ₃	F ₃	F ₄
Westmoreland silt loam.....	Lower third.....	F ₁	F ₂	F ₁	F ₂	F ₁	F ₃
	Middle third.....	F ₁	F ₂	F ₂	F ₃	F ₂	F ₃
	Upper third.....	F ₁	F ₃	F ₂	F ₃	F ₃	F ₄
Brooke silty clay loam.....	} (2).....	All sites.....	F ₁				
Huntington fine sandy loam.....							
Huntington silt loam.....							
Huntington silty clay loam.....	} (2).....	All sites.....	F ₄				
Lindside silt loam.....							
Melvin silt loam.....	} (2).....	All sites.....	F ₄				
Robertsville silt loam.....							
Lakin loamy sand.....	Uniform.....	All sites.....	F ₄				

¹ For severely eroded soils, add one to sites F₁, F₂, and F₃; thus F₁ becomes F₂, F₂ becomes F₃, and F₃ becomes F₄.

² Slope position does not affect site designation within group.

Culls and low-value species now occupy a large part of this site class.

Recommended species for planting on F_1 sites if natural reforestation does not occur are as follows: White pine, Scotch pine, Norway spruce, European or Japanese larch, black walnut, black locust, yellow-poplar, white ash, and red oak. Hardwoods should be planted only where rodents are not likely to be troublesome.

Natural reproduction, especially of yellow-poplar, is usually good on a few areas in this site class where the source of seed is nearby.

Soils in sites F_1 have an oak-site index of 75 or better. Growth in fully stocked stands of mixed oak should average about 250 board feet per acre per year, yielding about 20,000 board feet per acre at the age of 80 years. Yellow-poplar stands would yield somewhat more at younger ages, particularly if well managed.

F_2 —*Good*.—This class consists of sites good for woodland use. The number of suitable species and the growth rates are less than on F_1 sites. But intensive management can generally be justified. High-quality hardwoods can be grown on these sites on cutting cycles of 15 to 20 years. They can be grown for veneer logs, cooperage, and other specialty uses. Some cultural measures and location of permanent roads through the woods are feasible. About 35 percent of the woodland in Marshall County is in this site class.

The more demanding species of trees, as listed under F_1 sites, also occur here, but the oaks, particularly red oak, make up more of the stand. Some associated species are white ash, beech, and sugar maple.

Recommended species for planting on F_2 sites are white pine, Scotch pine, shortleaf pine, European or Japanese larch, white ash, and black locust.

In areas where seed sources of acceptable species are nearby and sod competition is not serious, natural reforestation sometimes occurs. Where natural reforestation is likely, planting may be delayed as long as 3 years until it is evident that reforestation will not occur naturally.

Site index for oaks on these sites runs from 65 to 75. Fully stocked stands should yield about 14,000 board feet per acre at 80 years, or an average growth of about 175 board feet per acre per year.

F_3 —*Medium*.—These sites can grow good timber, but long rotations are necessary. Intensive cultural measures, such as thinning or pruning, are not always profitable. Most areas are steep. The soils are shallow to moderately deep (fig. 6). Careful attention must be given to the location of roads and to erosion control measures on logging roads and skid trains to protect the soil and the streams. In some places, permanent logging roads are not desirable because of long cutting cycles of 20 to 30 years. About 35 percent of woodland in Marshall County is in this site class.

Oaks are the most abundant trees. Scarlet oak, chestnut oak, black oak, and white oak usually outnumber red oak. Some associated species are blackgum, hickory, and red maple in the older stands and sassafras and black locust in the volunteer stands.

Conifers should be given preference for reforestation on F_3 sites. Recommended species are white pine, Scotch pine, shortleaf pine, European or Japanese larch, white ash, and black locust (fig. 7).



Figure 6.—Scarlet, black, and chestnut oaks and red maple on F_2 site of Gilpin silt loam (30 percent slope), upper slope position, SW. exposure.

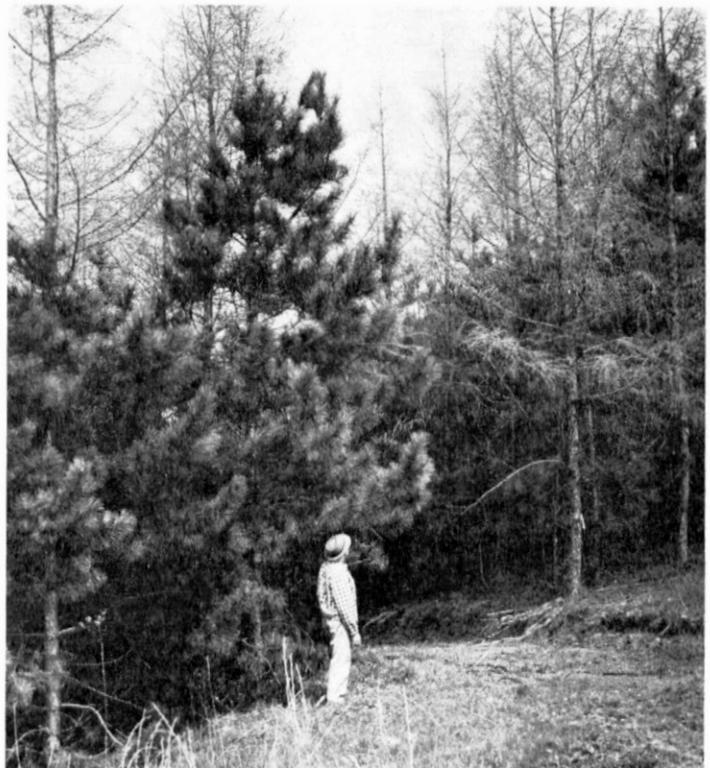


Figure 7.—A stand of Japanese larch and red pine, about 20 years old, on severely eroded Gilpin-Upshur soils.

Natural reforestation generally is not successful on these sites. Hickory and sassafras usually volunteer on abandoned pasture and cropland. Black locust comes in readily on the limestone soils.

Soils in site F_3 have an oak-site index of 55 to 65. Fully stocked stands can yield about 8,350 board feet

per acre at 80 years, or an average growth of about 100 board feet per acre per year.

F₄—Poor.—This class consists of sites not suitable for economic production of hardwood timber under present market conditions. Growth rates are slow and species are poor. Most of the soils are shallow and droughty. Slopes are usually steep or very steep. Sites are usually near the ridgetops and facing south or west. Erosion may be severe. Woodland improvement measures other than protection from grazing and fire are not recommended. The best use for these sites is for watershed protection, wildlife, and recreation. Small trees can be produced on accessible areas for some uses. Only about 10 percent of the wooded acreage of Marshall County is in this site class.

The poorest species of oaks dominate these sites. The trees are of low value. Scarlet oak, chestnut oak, black-gum, and hickory are typical species (fig. 8).



Figure 8.—Chestnut oaks dominate the growth on Gilpin soil (40 percent slope), *F₄* site, upper slope position, SW. exposure. These species grow slowly and have poor form.

Recommended species for *F₄* sites are as follows: On dry sites, Scotch pine, shortleaf pine, white pine, and Virginia pine (on the poorest sites); on wet sites, hemlock and northern white cedar.

White pine is favored on *F₄* sites that have some topsoil. Shortleaf pine can be used on all *F₄* sites.

Soils on *F₄* sites have an oak-site index of less than 55. Yields at 80 years from fully stocked stands are about 4,000 board feet. This is an average growth of only about 50 board feet per acre per year. These sites may yield better returns from pines than from hardwoods.

Uses of Woodland Site Classification

Woodland site classification information can be useful to the conservationist, forester, and landowner, and to those who buy woodland for investment purposes.

The approximate acreage of the various site classes on any property can be determined from the soil survey map.

This will show the potential values of the land for production of the different forest types or species for timber. Good woodland yield information is available for oak stands such as those in Marshall County (table 8). The yield figures in table 8 are conservative. They do not reflect the increased yield that could be harvested for thinnings under intensive management. Actual yields under management could well be twice the figures given for *F₁* and *F₂* sites.

Woodland site classification will help the owner to determine what cultural measures can be feasibly applied to his woodland. For example, thinning and pruning can be profitable on *F₁* and *F₂* sites, but doubtful on *F₃*, and economically unsound on *F₄* sites. The woodland owner can also use the classification to help determine what species to favor for growing stock and for planting.

TABLE 8.—Estimated yields per acre of even-aged, fully stocked oak stands on different site classes (3)

Site class	Yield at 50 years, merchantable stems, including bark, to 4 inches top, outside bark		Yield at 80 years; Scribner rule to an 8-inch top, inside bark, including all trees having at least one 16-foot log
	Cords	Cubic feet	Board feet
<i>F₁</i> -----	41	3,450	19,700
<i>F₂</i> -----	33	2,830	14,100
<i>F₃</i> -----	26	2,230	8,350
<i>F₄</i> -----	19	1,600	4,000

Engineering Applications⁴

This section summarizes the engineering characteristics of the soils of Marshall County and points out the principal features that are likely to affect engineering practices. It is provided to help engineers interpret for engineering purposes the soil survey information contained in this report. *It does not, however, eliminate the need for sampling and testing for design and construction of specific engineering works.*

The information in this report can be used to:

(1) Make soil and land use studies that will aid in the selection and development of industrial, business, residential, and recreational sites.

(2) Make preliminary estimates of the engineering properties of soils for use in planning agricultural drainage systems, farm ponds, irrigation systems, and diversion terraces.

(3) Make preliminary evaluations of soil and site conditions that will aid in selecting highway and airport locations and in planning detailed investigations of the selected locations.

(4) Develop other preliminary estimates of the engineering properties of the soils for construction pertinent to a particular area.

(5) Locate gravel and other construction materials.

(6) Correlate performance of engineering structures

⁴ This section was prepared jointly by the Division of Physical Research, Bureau of Public Roads, and Soil Conservation Service. Test data in table 11 were obtained in the Soils Branch, Bureau of Public Roads.

with soil mapping units and thus develop information that will be useful in designing and maintaining the structures.

(7) Determine the suitability of soil units for cross-country movements of vehicles and construction equipment.

(8) Supplement information obtained from other published maps, reports, and aerial photographs in order to make maps and reports that can be used readily by engineers.

Some terms used in this report are commonly used by both engineers and soil scientists, but they have significantly different meanings to each. The definitions of some of these terms, as used by the soil scientist, follow:

Aggregate: Many fine soil particles held in a single mass or cluster such as a clod, crumb, block, or prism.

Clay: A soil separate or size group of mineral particles less than 0.002 mm. in diameter. Clay as a textural class includes soil material that contains 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Granular structure: Individual grains grouped into spherical aggregates with indistinct sides. Highly porous granules are commonly called crumbs.

Sand: A soil separate having mineral particles ranging from 2.00 mm. to 0.05 mm. in diameter. As a textural class, sand includes soil material that contains 85 percent or more sand, and the percentage of silt plus 1½ times the percentage of clay shall not exceed 15.

Silt: A soil separate having mineral particles ranging from 0.05 mm. to 0.002 mm. in diameter. As a textural class, silt includes soil material that contains 80 percent or more silt and less than 12 percent clay.

Soil: The natural medium for the growth of land plants on the surface of the earth; composed of organic and mineral materials.

Topsoil: Presumably fertile soil or soil material, usually rich in organic matter, used to topdress roadbanks, gardens, and lawns.

Estimated Engineering Classification and Physical Properties of Soils

Estimated engineering classifications according to the Unified (?) and the American Association of State Highway Officials (AASHO) (I) systems are given in table 9. In addition, some estimated physical properties are given.

The two engineering classification systems shown in table 9 are based upon the use of the soil material in airfields and highways. The exact classifications, or groups, are determined from the results of mechanical analysis, liquid limit, and plastic limit tests. The classifications shown in table 9 were estimated from actual test data and from the descriptions given in the section Descriptions of Soil Series and Mapping units.

In the Unified system, two letters are used to designate each soil group. The letters used in table 9 include G, S, M, and C, which stand for gravel, sand, silt, and clay, respectively, and also W, P, L, and H, which stand for well graded, poorly graded, low plasticity, and high plasticity, respectively. Where the symbols of two soil separates

appear, as SM, for sand and silt, the first letter stands for the predominant soil separate.

In the AASHO system, soil materials are classified in seven principal groups. The groups range from A-1, gravelly soils of high-bearing capacity, to A-7, clay soils having low-bearing capacity when wet. Within each group, the relative value of the soil for engineering purposes is indicated by a group index number. These range from 0 for the best material to 20 for the poorest roadbuilding material. Group index numbers are shown in parentheses following the soil group symbol, for example, A-4(8) (see table 11).

In table 9, suitability as topsoil refers to suitability of the soil for use on cut and fill slopes for growing grass and other plants. The ratings depend primarily upon inherent fertility, organic-matter content, texture, and the presence or absence of large stone fragments.

Permeability refers to the movement of water through the soil material in place. The permeability depends largely upon the soil texture and structure.

Available moisture capacity is the amount of water in a moist soil that can be removed by plants. Field capacity, expressed in inches of water per foot of soil depth, is of particular value to engineers engaged in irrigation practices.

Shrink-swell potential is a rating of the ability of a soil material to change volume when subjected to changes in moisture. Those soil materials rated high are normally undesirable from the engineering standpoint, since the increase in volume when the dry soil is wetted is usually accompanied by a loss in bearing capacity.

Highway Engineering

Soil characteristics, or features, affecting highway engineering practices are rated, or pointed out, in table 10 in columns 2 through 5.

The rating of the soil material for road subgrade is based on the estimated AASHO classification of the soil materials that would normally be used in the subgrade. In flat terrain, the rating applies to the soil materials in the A and B horizons; in steeper terrain (6 percent slopes or steeper), it applies to the soil materials in the C horizon. Coarse-textured soil materials are rated good, and fine-textured materials fair or poor. The soil materials rated fair are silts with low plasticity; those rated poor are plastic clays that lose strength when wet. In areas where freezing occurs to depths greater than 6 inches and the water table is within 3 feet of the subgrade surface, silty materials should be rated poor instead of fair because they are very susceptible to damage by freezing and thawing.

The landslips, or landslides, referred to in table 10 are primarily detrital slides or debris flows. The upper few feet of soil material moves downhill over weathered bedrock or within colluvium at the foot of slopes. The ratings are based mainly upon field observations.

The vertical alignment, or placement, of the roadway is affected by factors listed under the two columns headed materials and drainage. Vertical alignment is influenced by the depth to bedrock and by the type of bedrock in areas where natural slopes are steeper than about 6 percent. Blasting will normally be required to excavate in deep cuts in unweathered shale and sandstone. The dif-

faculty of bedrock excavation and the chance of seepage along bedding planes in the bedrock should be investigated. The presence of undesirable soil material within or slightly below the subgrade will affect the stability of the roadbed. A layer of very plastic clay, as in the Wyatt series, will impede internal drainage and will usually have low stability when wet. Desirable soil material within the soil profile, for example, the sand and gravel in the Wheeling series, makes a naturally stable subgrade.

Vertical alignment is also influenced by local drainage conditions. To provide satisfactory drainage in areas that are occasionally or seasonally flooded, or where the water table is high, the pavement surface should be built at least 3 feet above high water or above the ground water table. Use of interceptor ditches or underdrains will control subsurface seepage. Seepage over impermeable strata in the back slopes of cuts can result in the sliding of the overlying material. If serious enough, the sliding will sometimes influence both the location and cross-sectional design of the roadway.

Natural base-course materials are scarce in Marshall County except along the Ohio River. The only sources of sand and gravel are the Wheeling soils. The Lakin soils in some places are a source of sand.

Conservation Engineering

Soil features that affect the application of water management practices are shown in table 10, columns 6 through 9. These features are evaluated on the basis of estimates taken from table 9, on actual test data from certain soils, and on field experience.

Soil drainage and the construction of farm ponds, diversion terraces, and waterways are the most important engineering practices used in this county. Diversion terraces and waterways are used mainly on the upland and colluvial soils of the Westmoreland, Gilpin, Gilpin-Upshur, Brookside, and Clarksburg series. These soils do not differ significantly in their behavior when these practices are used.

An important function of diversion terraces is to intercept hillside surface and subsurface water. Such water is often a chief source of wetness in the Clarksburg soils. It also causes small seep spots in both the Clarksburg and Brookside soils. Diversion terraces are commonly used along the toe of the hillside, adjacent to the bottom-land soils of the Melvin and Lindsides series. In such places, the terraces should be as deep as is feasible in order to intercept as much subsurface water as possible.

The hazard of slips should be recognized in the planning and construction of diversion terraces, particularly on the Gilpin-Upshur, Westmoreland, Clarksburg, and Brookside soils. The bottom of the channel must be exactly on grade so that ponding will not occur. Areas showing evidence of past slips should be avoided.

Soil characteristics and hazards pertaining to farm-pond construction are shown for each series in table 10. The Wheeling and Lakin soils are not generally suitable for ponds because of the rapid permeability of the sandy material. However, if extraordinary precautions are taken during construction and bentonite is used as a sealing agent, some successful ponds may be constructed on these soils.

Thin sandy layers, or lenses, occur in places in any of the alluvial soils of the Ashton, Huntington, Lindsides, Melvin, Holston, Monongahela, and Captina series. Detailed borings should be made, and sites with sand lenses should be avoided. Lenses in a pond reservoir can often be sealed by thorough mixing with finer material, adequate compaction, and use of suitable additives.

The upland soils of the Westmoreland, Gilpin, and Gilpin-Upshur series usually provide satisfactory farm-pond sites if the topography is favorable. Sandstone or shale bedrock occurs in places in these soils, particularly in the Gilpin, and is the main hazard in pond construction. Landslips are potential hazards on the Gilpin-Upshur and Westmoreland soils where there is seepage. Therefore, excessively steep side slopes around the edges of the reservoir area and in spillways should be avoided.

The Clarksburg and Brookside soils have many good pond sites, and the deep soil provides good construction material. The same precautions regarding landslips should be taken for these soils as for the Westmoreland and Gilpin-Upshur soils.

There are some hazards in pond construction on soils formed at least partially on limestone material, as the Brooke and Westmoreland. This is because of the likelihood of crevasses and seams in the underlying limestone. Ponds built in similar soils have been successfully sealed through the use of a polyphosphate dispersing agent.

The Lindsides and Melvin soils respond well to tile drainage. Tile lines are usually laid so as to intercept surface and subsurface water from adjacent upland areas. Seep spots may be drained by use of tile lines or diversion terraces. Such wet spots are common in the Clarksburg soils. They are less prevalent in the Brookside soils. Soils with a tight pan layer, such as the Guernsey, Monongahela, and Captina, do not usually respond well to tile drainage, unless the ditch is backfilled with gravel to the top of the slowly permeable layer.

Very little irrigation is practiced at the present time in the county. The Wheeling and Ashton soils are well suited for irrigation, but these soils are rapidly going out of agricultural use. The Gilpin and Westmoreland soils would be suitable for irrigation if a water source were available. The soils with slowly permeable layers at 18 to 28 inches, as the Monongahela, are suitable for irrigation, but their water storage capacity is limited by the pan layer.

Residential Development

Soil characteristics have an important bearing on the suitability of a site for residential development. Soil drainage, depth to bedrock, the nature of the subsoil, and hazard of flooding are factors to be considered in planning residential developments.

Soils with poor internal drainage are poorly suited for construction sites. Sewage disposal systems will not function properly in soils with a seasonally high water table or in soils with slowly permeable subsoils. Dry basements are difficult to construct in wet and slowly permeable soils.

Soils that tend to slip readily should be avoided in selecting building sites. Areas of bottom-land soils that are subject to flooding are also poorly suited for residential or other building sites.

The Wheeling soils, along the Ohio River terraces, offer nearly ideal building sites. They are deep, well-drained,

TABLE 9.—*Brief description and estimated engineering*

Map symbol	Soil name	Depth to seasonally high water table	Depth to bedrock	Brief site and soil description
		<i>Feet</i>	<i>Feet</i>	
Aa Ab	Ashton silt loam, 0 to 3 percent slopes--- Ashton silt loam, 3 to 12 percent slopes---	3+-----	6+	{Stratified alluvial materials ranging from sandy loam to silty clay loam, derived from limestone-influenced upland; low terraces above normal overflow.
Ba Bb	Brooke silty clay loam, 8 to 20 percent slopes. Brooke silty clay loam, 20 to 40 percent slopes.	10+-----	3 to 4	{About 1 foot of silty clay loam on 2 to 3 feet of clay, underlain by limestone or calcareous shale; occur on rounded ridgetops and benches or saddles between ridgetops.
Bc Bd Be Bf Bg Bh	Brookside silt loam, 3 to 8 percent slopes. Brookside silt loam, 8 to 15 percent slopes. Brookside silt loam, 15 to 25 percent slopes. Brookside silt loam, 15 to 25 percent slopes, severely eroded. Brookside silt loam, 25 to 35 percent slopes. Brookside silt loam, 25 to 35 percent slopes, severely eroded.	5+-----	5 to 10	{5 to 10 feet of mainly silty clay loam or silty clay colluvium derived from limestone, sandstone, and shale; quantity of stone fragments increases below depth of 3 feet.
Ca	Captina silt loam, 3 to 8 percent slopes---	1½ to 2 (perched)---	5+	About 1 foot of silt loam on silty clay loam, derived from sandstone and shale; fragipan, 1 to 2 feet thick, occurs at depth of 1½ to 2 feet; terrace above normal overflow.
Cb Cc Cd Ce	Clarksburg silt loam, 3 to 8 percent slopes. Clarksburg silt loam, 8 to 15 percent slopes. Clarksburg silt loam, 15 to 25 percent slopes. Clarksburg silt loam, 15 to 25 percent slopes, severely eroded.	2 to 3 (perched)----	5 to 10	{½ to 1 foot of silt loam on about 1½ feet of silty clay loam; slowly permeable layer, about 2 to 3 feet thick, at depth of about 2 feet; colluvium derived from limestone, sandstone, and shale.
Ga Gb Gc Gd Ge Gf Gg Gh	Gilpin silt loam, 3 to 10 percent slopes--- Gilpin silt loam, 10 to 20 percent slopes--- Gilpin silt loam, 20 to 30 percent slopes--- Gilpin silt loam, 20 to 30 percent slopes, severely eroded.----- Gilpin silt loam, 30 to 40 percent slopes--- Gilpin silt loam, 30 to 40 percent slopes, severely eroded. Gilpin silt loam, 40 to 55 percent slopes--- Gilpin silt loam, 40 to 55 percent slopes, severely eroded.	10+-----	1½ to 3	{Mainly silt loam or silty clay loam with shale fragments on interbedded sandstone, siltstone, and shale; occur on narrow ridgetops and hillsides.
Gk Gm Gn Go Gp Gr Gs Gt Gu Gv Gw	Gilpin-Upshur silty clay loams, 3 to 10 percent slopes. Gilpin-Upshur silty clay loams, 10 to 20 percent slopes. Gilpin-Upshur silty clay loams, 10 to 20 percent slopes, severely eroded. Gilpin-Upshur silty clay loams, 20 to 30 percent slopes. Gilpin-Upshur silty clay loams, 20 to 30 percent slopes, severely eroded. Gilpin-Upshur silty clay loams, 20 to 30 percent slopes, very severely eroded. Gilpin-Upshur silty clay loams, 30 to 40 percent slopes. Gilpin-Upshur silty clay loams, 30 to 40 percent slopes, severely eroded. Gilpin-Upshur silty clay loams, 30 to 40 percent slopes, very severely eroded. Gilpin-Upshur silty clay loams, 40 to 55 percent slopes. Gilpin-Upshur silty clay loams, 40 to 55 percent slopes, severely eroded.	10+-----	1½ to 3	{Gilpin soils are described above. Upshur component of complex is not mapped separately. Upshur: ½ to 1 foot of silty clay loam on plastic clay, derived from interbedded gray sandstone, acid gray shale, and alkaline clay shale; occupy ridgetops and hillsides.

classification and physical properties of soils

Depth from surface (typical profile)	Classification		Suitability as topsoil	Permeability	Structure	Available moisture capacity	Shrink- swell potential
	Unified	AASHO					
Inches 0 to 10 10 to 22 22 to 38+	SM.....	A-4.....	Good.....	Inches per hour 0.8 to 5.0 .8 to 5.0 5 to 10	Granular.....	Inches per foot of depth 1.4 to 1.8 1.4 to 1.8 1.0 to 1.4	Low. Low. Low.
	ML.....	A-4.....	Good.....		Subangular blocky...		
	SC.....	A-2 or A-4...	Good.....		Subangular blocky...		
0 to 5 5 to 10 10 to 20 20 to 40+	CL.....	A-6.....	Good.....	.2 to .8 .2 to .8 .05 to .2 .05 to .2	Granular.....	1.4 to 1.8 1.4 to 1.8 1.0 to 1.4 1.0 to 1.4	Moderate. High. High. High.
	CL.....	A-6 or A-7...	Good.....		Coarse blocky.....		
	CH.....	A-7.....	Fair.....		Medium blocky.....		
	CH.....	A-7.....	Fair.....		Massive.....		
0 to 7 7 to 12 12 to 28 28 to 40+	ML.....	A-4.....	Good.....	.8 to 5.0 .8 to 5.0 .2 to .8 .2 to .8	Granular.....	1.4 to 1.8 1.4 to 1.8 1.4 to 1.8 1.0 to 1.4	Moderate. Moderate. Moderate. Moderate.
	CL.....	A-6.....	Good.....		Subangular blocky...		
	CL.....	A-6 or A-7...	Fair.....		Subangular blocky...		
	CL.....	A-6.....	Poor.....		Weak coarse pris- matic.		
0 to 12 12 to 19 19 to 30 30+	ML.....	A-4.....	Good.....	.8 to 5.0 .2 to .8 .05 to .2 .05 to .2	Granular.....	1.4 to 1.8 1.4 to 1.8 1.0 to 1.4 1.0 to 1.4	Low. Low. Low. Low.
	CL.....	A-6.....	Fair.....		Subangular blocky...		
	CL.....	A-6.....	Poor.....		Blocky.....		
	CL.....	A-6.....	Poor.....		Massive.....		
0 to 8 8 to 17 17 to 25 25 to 60+	ML.....	A-4.....	Good.....	.8 to 5.0 .8 to 5.0 .05 to .2 .05 to .2	Granular.....	1.4 to 1.8 1.4 to 1.8 1.0 to 1.4 1.0 to 1.4	Moderate. Moderate. Moderate. Moderate.
	CL.....	A-6.....	Fair.....		Subangular.....		
	CL.....	A-6.....	Fair.....		Blocky to massive...		
	CL or CH...	A-7.....	Poor.....		Massive.....		
0 to 9 9 to 13 13 to 22 22 to 25	ML.....	A-4.....	Good.....	.8 to 5.0 .8 to 5.0 .2 to .8 .2 to .8	Granular.....	1.4 to 1.8 1.4 to 1.8 1.4 to 1.8 1.0 to 1.4	Low. Low. Moderate. Low.
	ML.....	A-4.....	Fair.....		Platy.....		
	CL.....	A-6.....	Fair.....		Subangular blocky...		
	ML to CL...	A-4 or A-6...	Poor.....		Subangular blocky...		
0 to 6 6 to 14 14 to 25 25+	CL.....	A-6.....	Fair.....	.2 to .8 .05 to .2 .05 to .2 .05 to .2	Granular.....	1.4 to 1.8 1.4 to 1.8 1.0 to 1.4 1.0 to 1.4	Moderate. High. High. High.
	CH.....	A-7.....	Poor.....		Medium blocky.....		
	CH.....	A-7.....	Poor.....		Massive.....		
	GC.....	A-2 or A-7...	Unsuitable...		Massive.....		

TABLE 9.—*Brief description and estimated engineering*

Map symbol	Soil name	Depth to seasonally high water table	Depth to bedrock	Brief site and soil description
Gx Gy Gz	Guernsey silt loam, 3 to 10 percent slopes. Guernsey silt loam, 10 to 20 percent slopes. Guernsey silt loam, 20 to 30 percent slopes, severely eroded.	1½ to 2 (perched) ---	3 to 5	½ to 1 foot of silt loam on silty clay over clay shale; claypan, about 1 foot thick, at depth of 1¼ to 2 feet; occur on upper benches and broad ridgetops.
Ha Hb Hc	Holston silt loam, 2 to 8 percent slopes. Holston silt loam, 8 to 15 percent slopes. Holston silt loam, 15 to 25 percent slopes.	10+ -----	5 to 10	About 1 foot of silt loam on clay loam or silty clay loam; alluvium derived from sandstone and shale; terrace above normal high water.
Hd He Hf	Huntington fine sandy loam, 0 to 3 percent slopes. Huntington silt loam, 0 to 3 percent slopes. Huntington silty clay loam, 0 to 3 percent slopes.	0 to 3 -----	5 to 12	3 to 5 feet of alluvial materials ranging from fine sandy loam to silty clay loam on stratified materials; derived from sandstone and shale with some limestone; bottom lands, subject to occasional flooding.
La	Lakin loamy sand, 10 to 20 percent slopes.	10+ -----	10 to 30	Irregular or hummocky deposits of wind-blown materials, 10 to 30 feet deep, on terraces; texture ranges from loamy sand to loamy fine sand.
Lb	Lindside silt loam, 0 to 3 percent slopes.	0 to 2 -----	3 to 8	3 to 5 feet of alluvial materials ranging from silt loam to silty clay loam on stratified materials derived from recent alluvium washed from lime-influenced upland soils; on bottom lands that are occasionally or frequently flooded.
Ma	Made land -----	-----	-----	Industrial sites and towns where natural soil features have been destroyed.
Mb	Melvin silt loam, 0 to 3 percent slopes.	0 to 1 -----	3 to 8	Soil materials about the same as for Lindside soils except that sand and gravel may occur at depths greater than 3 feet; bottom lands that are subject to frequent flooding.
Mc	Mine dumps -----	-----	-----	Generally piles of waste materials, coal, and slate.
Md Me	Monongahela silt loam, 2 to 8 percent slopes. Monongahela silt loam, 8 to 15 percent slopes.	1½ to 2 -----	5 to 8	1½ to 2 feet of mainly silt loam on 2 to 3 feet of slowly permeable sandy clay loam or sandy loam, derived from sandstone and shale; terraces above normal flood level.
Ra	Robertsville silt loam, 0 to 5 percent slopes.	0 -----	5+	1 to 1½ feet of silt loam or silty clay loam on silty clay, alluvium from lime-influenced upland soils; occupies wet spots or depressed areas on terraces.
Wa Wb Wc Wd We Wf Wg Wh Wk	Westmoreland silt loam, 3 to 10 percent slopes. Westmoreland silt loam, 10 to 20 percent slopes. Westmoreland silt loam, 10 to 20 percent slopes, severely eroded. Westmoreland silt loam, 20 to 30 percent slopes. Westmoreland silt loam, 20 to 30 percent slopes, severely eroded. Westmoreland silt loam, 30 to 40 percent slopes. Westmoreland silt loam, 30 to 40 percent slopes, severely eroded. Westmoreland silt loam, 40 to 55 percent slopes. Westmoreland silt loam, 40 to 55 percent slopes, severely eroded.	20+ -----	2½ to 4	About 1 foot of silt loam on about 1 foot of silty clay loam, on silty clay loam that has high content of mainly siltstone fragments; bedrock is interbedded shale, siltstone, and sandstone with some limestone; occur on ridgetops and hillsides.

classification and physical properties of soils—Continued

Depth from surface (typical profile)	Classification		Suitability as topsoil	Permeability	Structure	Available moisture capacity	Shrink-swell potential
	Unified	AASHO					
Inches 0 to 14 14 to 23	ML or CL	A-4 or A-6	Good	Inches per hour 0.8 to 5.0 .2 to .8 .05 to .2	Granular	Inches per foot of depth 1.4 to 1.8 1.4 to 1.8 1.0 to 1.4	Low. Moderate. Moderate.
	MH or CH	A-7	Fair		Weak coarse prismatic.		
	MH or CH	A-7	Poor		Massive		
0 to 14 14 to 34+	ML	A-4	Good	.8 to 5.0 .2 to .8	Granular	1.4 to 1.8 1.4 to 1.8	Low. Low to moderate.
	CL	A-6	Fair		Subangular blocky		
0 to 24 24 to 45+	ML	A-4	Good	.8 to 5.0 .8 to 5.0	Granular	1.8 to 2.2 1.4 to 1.8	Low. Low.
	CL	A-6	Good		Subangular blocky		
0 to 60+	SM	A-2	Unsuitable	10.0+	Single grain	Less than 1.0	Low to none.
0 to 24 24 to 36+	ML	A-4	Good	.8 to 5.0 .2 to .8	Granular	1.8 to 2.2 1.4 to 1.8	Low. Moderate.
	CL	A-6	Good		Structureless		
0 to 8 8 to 36 36+	ML	A-4	Good	.8 to 5.0 .05 to .8 10.0+	Granular	1.4 to 1.8 1.4 to 1.8 Less than 1.0	Low. Moderate. Low to none.
	CL	A-6	Fair		Massive		
	GM or SM	A-2	Unsuitable		Single grain		
0 to 13 13 to 21 21 to 56	ML	A-4	Fair	.8 to 5.0 .8 to 5.0 .05 to .2	Granular	1.4 to 1.8 1.4 to 1.8 Less than 1.0	Low. Low. Moderate.
	ML	A-4	Fair		Subangular blocky		
	SC or CL	A-6 or A-7	Poor		Massive		
0 to 8 8 to 15 15 to 30+	ML	A-4	Good	.8 to 5.0 .2 to .8 .05 to .2	Granular	1.4 to 1.8 1.4 to 1.8 1.0 to 1.4	Low. Low. Moderate.
	CL	A-6	Fair		Prismatic		
	MH or CH	A-7	Poor		Massive		
0 to 8 8 to 13 13 to 26 26 to 35	ML or CL	A-4	Good	.8 to 5.0 .8 to 5.0 .8 to 5.0 .2 to .8	Granular	1.8 to 2.2 1.4 to 1.8 1.4 to 1.8 1.4 to 1.8	Low. Moderate. Moderate. Moderate.
	ML or CL	A-4	Good		Subangular blocky		
	CL	A-6	Fair		Subangular blocky		
	GC	A-2	Fair		Blocky		

TABLE 9.—*Brief description and estimated engineering*

Map symbol	Soil name	Depth to seasonally high water table	Depth to bedrock	Brief site and soil description
Wm Wn	Wheeling sandy loam, 0 to 3 percent slopes. Wheeling sandy loam, 3 to 10 percent slopes.	10+-----	50+	{ About 1½ feet of sandy loam over 1 foot of sandy loam or sandy clay loam over 1 foot of loose fine sandy loam over stratified sand and gravel; occur as local gravel bars.
Wo Wp	Wheeling silt loam, 0 to 3 percent slopes. Wheeling silt loam, 3 to 10 percent slopes.	10+-----	50+	{ 1 to 1½ feet of silt loam on 2 to 4 feet of sandy clay loam or silty clay loam, on stratified silt, sand, and gravel; coarseness increases with depth; terraces above normal flooding.
Wr Ws	Wyatt silt loam, 3 to 8 percent slopes. Wyatt silt loam, 15 to 30 percent slopes.	15+-----	20+	{ About 1½ feet of silt loam or silty clay loam on clay; alluvium derived from interbedded sandstone, shale, and limestone; occur as slack-water terrace deposits.

TABLE 10.—*Engineering*

Soil series and map symbol	Suitability of soil material for road subgrade	Susceptibility to landslides	Vertical alignment for highways	
			Materials	Drainage
Ashton Aa, Ab	Fair	Low to none	(1)	Infrequent flooding
Brooke Ba, Bb	Poor	Moderate	Plastic clay; bedrock	(1)
Brookside Be, Bd, Be, Bf, Bg, Bh	Fair to poor	Moderate	(1)	(1)
Captina Ca	Fair	Low	(1)	Seepage at 1½ to 2 feet
Clarksburg Cb, Cc, Cd, Ce	Fair to poor	High	Bedrock	Seepage at 2 to 3 feet
Gilpin Ga, Gb, Gc, Gd, Ge, Gf, Gg, Gh	Fair	Low	Bedrock	(1)
Gilpin-Upshur Gk, Gm, Gn, Go, Cp, Cr, Cs, Gt, Gu, Gv, Gw	Fair to poor	High; serious landslide hazard on slopes over 20 percent.	Plastic clay; bedrock	(1)
Guernsey Gx, Gy, Gz	Fair to poor	Low	Bedrock	Seepage at 1½ to 2 feet
Holston Ha, Hb, Hc	Fair to poor	Low to none	(1)	(1)
Huntington Hd, He, Hf	Fair	Low to none	(1)	Water table; occasionally flooded.
Lakin La	Good	Low to none	(1)	(1)
Lindside Lb	Fair	Low to none	(1)	Water table; occasionally flooded.
Melvin Mb	Fair ³	Low to none	(1)	Water table; frequently flooded.
Monongahela Md, Me	Fair to poor	Low to none	(1)	Water table

See footnotes at end of table.

classification and physical properties of soils—Continued

Depth from surface (typical profile)	Classification		Suitability as topsoil	Permeability	Structure	Available moisture capacity	Shrink-swell potential
	Unified	AASHO					
0 to 9 9 to 15 15 to 25	SM	A-4	Good	Inches per hour 5.0 to 10.0	Single grain	Inches per foot of depth 1.0 to 1.4	Low.
	SM	A-4	Fair		Single grain		
	SM, SC, or CL	A-4 or A-6	Fair		Subangular blocky		
25 to 36 36+	SM	A-2 or A-4	Poor	10.0+	Single grain	Less than 1.0	Low.
	GP or SM	A-2	Unsuitable	10.0+	Single grain	Less than 1.0	Low to none.
0 to 14 14 to 30 30 to 56 56 to 72 72+	ML or CL	A-4	Good	.8 to 5.0	Granular	1.8 to 2.2	Low.
	CL	A-6	Fair	.8 to 5.0	Subangular blocky	1.4 to 1.8	Low.
	ML or CL	A-4 or A-6	Fair	.8 to 5.0	Subangular blocky	1.4 to 1.8	Low.
	SM or MI	A-2 or A-4	Unsuitable	5.0 to 10.0	Subangular blocky	1.0 to 1.4	Low.
	GW, GP, or GM	A-1 or A-2	Unsuitable	10.0+	Single grain	Less than 1.0	Low to none.
0 to 8 8 to 16 16 to 25 25+	ML	A-4	Good	.2 to .8	Granular	1.4 to 1.8	Low.
	CL	A-6	Fair	.05 to .2	Subangular blocky	1.0 to 1.4	Moderate.
	CH	A-7	Poor	.05 to .2	Subangular blocky	1.0 to 1.4	Moderate.
	CH	A-7	Poor	.05 to .2	Prismatic	1.0 to 1.4	Moderate.

interpretation of soils

Farm ponds		Agricultural drainage	Irrigation
Reservoir area	Embankment		
Very limited suitability; sandy substratum.	Limited suitability; low shear strength.	Good natural drainage	Suitable; high available moisture-holding capacity; responds well.
Very limited suitability; limestone bedrock.	Very limited suitability; high shrink-swell; danger of slumping.	Good natural drainage	Not suitable; low infiltration rate.
Suitable; good sites	Suitable	Some seep spots	Suitable.
Limited suitability; occasional sandy layers.	Limited suitability; low shear strength.	Compact layer at 18 to 26 inches.	Suitable; slow permeability at 18 to 26 inches.
Suitable; good sites	Suitable	Compact layer at 18 to 26 inches; hillside seepage.	Suitable; slow permeability at 18 to 26 inches.
Limited suitability; occasional sandstone or shale layers.	Suitable	Well drained	Suitable on gentle slopes.
Suitable	Suitable; some slump hazard	Well drained	Not suitable; low infiltration rate.
Suitable	Suitable	Perched water on claypan at 18 to 26 inches.	Suitable; slow permeability at 18 to 26 inches.
Very limited suitability; sandy layers.	Limited suitability; low shear strength.	Well drained	Suitable.
Very limited suitability; sandy lenses and substratum.	Limited suitability; low shear strength.	Well drained	Suitable; high available moisture-holding capacity.
Not suitable; rapidly permeable	(?)	Excessively drained	Suitable; low available moisture-holding capacity.
Usually suitable; occasional sand lenses.	Limited suitability; low shear strength.	Moderately well to somewhat poorly drained; somewhat slow permeability.	Suitable; high available moisture-holding capacity.
Suitable	Same	High water table; moderate to slow permeability.	Not suitable.
Limited suitability; may have sandy lenses.	Suitable	Moderately well drained; pan at 18 to 28 inches.	Suitable; slow permeability at 18 to 28 inches.

TABLE 10.—Engineering

Soil series and map symbol	Suitability of soil material for road subgrade	Susceptibility to landslides	Vertical alignment for highways	
			Materials	Drainage
Robertsville..... Ra	Fair to poor.....	Low to none.....	(¹).....	Water table.....
Westmoreland..... Wa, Wb, Wc, Wd, We, Wf, Wg, Wh, Wk	Fair.....	Low to none.....	Bedrock.....	(¹).....
Wheeling..... Wm, Wn, Wo, Wp	Fair ²	Low to none.....	Sand and gravel....	(¹)
Wyatt..... Wr, Ws	Fair to poor.....	Low to none.....	Plastic clay.....	(¹)

¹ This feature will have little or no effect.

² Soil material is generally too permeable for farm ponds.

TABLE 11.—Engineering test data ¹ for

Soil name and location	Parent material	Bureau of Public Roads report number	Depth	Horizon	Moisture-density ²		Mechanical	
					Maximum dry density	Optimum moisture	Discarded in field sampling	
							Larger than 3 in.	3 in. to 1 in.
Brookside silt loam: 2 miles NW. of mouth of Bruce Run, Marshall County (modal profile).	Colluvium.....	S 31850	<i>Inches</i> 14-28	B ₂	<i>Lb. per cu. ft.</i> 109	<i>Percent</i> 19	-----	-----
		S 31851	36-50	B ₃	112	17	-----	-----
6 miles SE. of Graysville, Marshall County.	Colluvium.....	S 31852	20-30	B ₂	110	16	8	-----
		S 31853	39-65+	B ₃	113	15	3	-----
Westmoreland silt loam: Near intersection of county highways 8 and 2/4, NE. of Glen Dale, Marshall County (modal profile).	Interbedded shale, siltstone, sandstone, and limestone.	S 31854	0-8	A _p	106	17	-----	-----
		S 31855	13-26	B ₂	111	17	-----	-----
		S 31856	26-35	C ₁	115	15	21	21
1 mile S. of Glen Easton, Marshall County.	Same.....	S 31857	2-8	A ₂	106	19	-----	-----
		S 31858	8-16	B ₂	114	15	-----	-----
		S 31859	16-30	C	115	14	21	21
Wheeling silt loam: 2 miles N. of Williamstown, Wood County (modal profile).	Terrace sand, silt, and gravel.	S 31860	0-10	A _p	106	16	-----	-----
		S 31861	14-34	B ₂	111	16	-----	-----
		S 31862	34-58	B ₃₁	113	13	-----	-----
		S 31863	64-74+	D	127	9	12	3
Wheeling fine sandy loam: Washington Bottom, Wood County (modal profile).	Same.....	S 31864	0-8	A _p	116	13	-----	-----
		S 31865	12-25	B ₂	124	10	-----	-----
		S 31866	36-45+	D	127	9	12	3

¹ Tests performed by Bureau of Public Roads in accordance with standard procedures of the American Association of State Highway Officials (AASHO) (1).

² Moisture-density test performed in accordance with AASHO T 99-57.

³ Mechanical analysis according to the Designation: T 88. Results by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 mm. in diameter. In the SCS soil survey procedure, the fine material is analyzed by the

interpretation of soils—Continued

Farm ponds		Agricultural drainage	Irrigation
Reservoir area	Embankment		
Suitable.....	Suitable.....	Slow permeability; needs surface drainage.	Not suitable.
Generally suitable.....	Suitable.....	Well drained.....	Suitable on gentle slopes.
Not suitable; sandy and gravelly substratum.	(?).....	Well drained.....	Suitable.
Suitable.....	Limited suitability; low shear strength.	Slow permeability.....	Not suitable.

³ Good subgrade material (sand and gravel) occurs at shallow depth.

soil samples taken from 6 soil profiles

analysis ³											Percentage smaller than ⁴				Liquid limit	Plasticity index	Classification	
Percentage passing sieve ⁴																	AASHO ⁵	Unified ⁶
3-in.	2-in.	1½-in.	1-in.	¾-in.	½-in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 60 (0.25 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.				
---	---	100	99	99	98	96	92	87	86	79	76	64	41	29	40	16	A-6(10)	ML-CL
---	---	---	100	99	99	97	93	87	85	78	75	62	40	26	33	11	A-6(8)	ML-CL
92	---	---	90	90	88	86	82	77	75	69	66	55	40	29	40	16	A-6(10)	ML-CL
97	---	---	97	96	92	89	84	78	77	70	68	55	35	23	36	15	A-6(9)	CL
---	---	---	---	---	---	100	97	95	89	86	67	34	22	30	6	A-4(8)	ML-CL	
---	---	---	---	---	---	100	96	94	89	86	68	43	32	38	16	A-6(10)	CL	
79	---	57	54	42	32	28	27	26	25	25	21	12	8	34	11	A-2-6(0)	GC	
---	100	99	98	95	93	91	87	86	76	72	54	27	18	32	7	A-4(8)	ML-CL	
---	100	99	97	93	90	86	84	82	72	67	52	31	21	26	5	A-4(7)	ML-CL	
79	---	57	54	46	41	38	37	36	35	33	24	15	10	32	10	A-4(2)	GC	
---	---	---	100	99	99	99	98	97	92	86	54	26	18	28	5	A-4(8)	ML-CL	
---	---	---	---	---	---	100	94	84	84	84	48	27	23	32	11	A-6(8)	CL	
---	---	---	---	---	---	100	99	70	57	29	13	13	13	21	1	A-4(7)	ML	
97	---	84	78	58	41	30	16	8	5	5	3	3	3	⁷ NP	⁷ NP	A-1-a(0)	GW-GM	
---	---	---	---	---	---	100	97	75	36	34	25	14	10	⁷ NP	⁷ NP	A-4(0)	SM	
---	---	---	---	---	---	100	98	71	46	34	29	17	12	⁷ NP	⁷ NP	A-4(2)	SM	
97	---	82	79	69	52	34	21	14	10	10	8	6	5	25	10	A-2-4(0)	GP-GC	

pipette method and the material coarser than 2 mm. in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming texture classes for soils.

⁴ Based on total material. Laboratory test data corrected for amount discarded in field sampling.

⁵ The Classification of Soils and Soil-Aggregate Mixtures for Highway Purposes, AASHO Designation: M 145-49.

⁶ The Unified Soil Classification System, Tech. Memo. 3-357, v. 1, Waterways Experiment Station, Corps of Engineers, March 1953, (?).

⁷ NP—nonplastic.

above overflow level, and not subject to slipping. The Ashton soils also have favorable internal characteristics but are sometimes flooded during extremely high floods. The Huntington soils are deep and well drained but subject to occasional flooding. The Lindsides and Melvin soils are poorly suited for residential development because they have a seasonally high water table and are subject to flooding.

The Westmoreland and Gilpin soils are favorable for residential development, except that bedrock usually occurs at depths of from 2 to 3 feet. Slips may occur in these soils on slopes over 20 percent where there is hillside seepage. The Upshur soils have a very plastic, slowly permeable subsoil and are subject to severe slips on slopes over 15 percent.

Brookside, Guernsey, and Clarksburg soils have moderate problems when used as construction sites. Construction of dry basements is somewhat difficult because the subsoils are subject to seepage. Occasional slips also occur in these soils.

Characteristics of the other soils in the county, which are of minor extent, are given in tables 9 and 10, and in the section Descriptions of Soil Series and Mapping Units.

Engineering Test Data

Six soil samples were tested according to standard procedures (1) to help evaluate the soils of Marshall County for engineering purposes. The samples were from three soil series—Brookside, Westmoreland, and Wheeling—as soils of these series cover more than 52 percent of the county. Four of the samples were from sites within the county; the remaining two were from locations outside the county. The test data are given in table 11 (pages 32, 33). The soil materials tested were obtained from relatively shallow depths, less than about 6 feet, and are not generally representative of materials at greater depths.

Planning Engineering Soil Surveys

At construction sites, major soil variations may occur within the depth of proposed excavation, and several soils may be encountered within a small area. The soil map and profile descriptions, as well as the engineering descriptions given in this section, should be used in planning detailed surveys of soils at construction sites. The soil survey information in this report will enable the soils engineer to concentrate on the most significant soils. A minimum number of soil samples will then be required for laboratory testing, and an adequate investigation can be made at least expense.

Formation and Classification of Soils

Factors of Soil Formation

The main factors that affect soil formation are (1) parent material, (2) climate, (3) topography, (4) living matter, and (5) time. Recently man's activities have influenced soils as they are found today. Soil formation proceeds slowly and gradually. The soil-forming factors do not act singly but are interrelated. For example, the kind of bedrock and climate influence the kind of vegeta-

tion that grows on a soil. The kind of vegetation, in turn, influences chemical and biological processes at work in a soil.

Parent material

Parent material is the unconsolidated mass from which the soil is formed. In Marshall County this material was derived through the breaking up of underlying rock, the deposition of colluvium on slopes, and the depositions by water and wind.

The bedrock in Marshall County is all of upper Carboniferous age. Almost all of the exposed rocks are of the Dunkard geologic series. The exception is a narrow band of the Monongahela series in the Ohio River bluffs and along some of the main tributaries.

The dominant rocks are gray sandstone; gray acid shale and siltstone; red or greenish gray, calcareous clay shale; gray alkaline shale; and limestone. These rocks occur as strata or beds that are generally horizontal and of moderate thickness. Dissection of the land surface has, therefore, exposed a number of rock strata in most places. Valleys have been cut down through several formations. Two or more kinds of rocks are often exposed on the same slope. Thus, the slope of a ridge may consist of a succession, from top to bottom, of beds of sandstone and shale. Others consist of a succession of limestone and shale strata, and so on. These rock strata have markedly influenced the soils formed from them.

Limestone is extensive in the northern two-thirds of the county; much of it is interbedded with shale. Little limestone occurs in the southern third. The extensive Westmoreland soils were derived from limestone interbedded with acid and alkaline gray shale and siltstone. The associated Brooke soils occur in small areas where the parent rock is all or very nearly all limestone.

In the southern third of the county, the rocks are mostly interbedded sandstone, acid gray shale, siltstone, and red clay shale. The Gilpin-Upshur soils have been formed from these rocks.

Gray sandstone, acid gray shale, and siltstone are dominant in a belt extending westward from the Pennsylvania line near Cameron to the vicinity of Rosbys Rock. The Gilpin soils were derived from these rocks.

Colluvial deposits of various thickness lie at the foot of every steep slope. These deposits consist of sediments washed or rolled downslope from the soils and weathering bedrock above. They are mixtures of materials found on the slopes above them. Brookside and Clarksburg soils formed from such deposits.

Glaciofluvial deposits of sand and gravel occur in terraces along the Ohio River. These sediments were deposited in valleys downstream from glaciers lying to the north and are presumably of Wisconsin Glacial age. They are of mixed mineralogy and contain small amounts of carbonates. They are extensive in the county and have given rise to Wheeling soils.

Fine-textured alluvium was laid down in slack-water areas along major streams and in ponds. This alluvium forms parent materials for the Wyatt soils.

Sandy deposits were laid down by wind, water, or both, in local spots within a mile or two east of the Ohio River. Lakin soils have been formed from these sandy sediments.

Alluvial materials other than the glaciofluvial sediments and slack-water deposits have been laid down in the many

valleys in the county. These deposits are dominantly silt, sand, or a mixture of the two. Where they are part of the present flood plain, they give rise to the Huntington, Lindside, and Melvin soils. Other alluvial deposits were laid down by the same streams at earlier periods in their history or by other streams at some time in the past. These older deposits remain as terraces at various levels above present flood plains. Soils on the lower terraces are members of the Ashton and Captina series. Soils on the higher terraces are of the Holston and Monongahela series.

Climate

Temperature and precipitation are generally uniform for all parts of Marshall County. Thus, climate is not responsible to any great extent for local soil differences. Climate acting with other soil-forming factors, however, is important in producing some of the major characteristics found in the dominant soils of the county. All of the extensive soils, for example, are low in organic matter and fairly well leached of bases in the upper part of the solum.

Topography

The lay of the land has a major influence on soil-forming processes. On gentle and moderately steep slopes, except for flood plains, the soils are mature and have prominently developed horizons. Easily weatherable minerals have been decomposed, and leaching has removed most of the

bases from these soils. On steep slopes, geologic erosion has tended to keep abreast of soil-forming processes. The soils are shallow and have more weakly developed horizons than those on less steep slopes.

Marshall County's topography is that of a thoroughly dissected plateau. From the ridgetops, the horizon appears to be nearly level. This is the level of the old peneplain. This plain is so thoroughly cut up by the past and present drainage systems that the topography now consists of ridges with rounded tops. These ridgetops average about 15 to 30 percent in slope and about an eighth to a fourth of a mile in width. These ridges have steep sides that average about 30 to 45 percent in slope. The drainage system is dendritic and has many branches. The stream heads have worked up the slopes so that the ridgetops are usually a series of knobs and saddles. The saddles are where stream heads reach toward the top from opposite sides of the ridge. Along these small side streams, the slopes are usually very steep, often as much as 40 to 60 percent, but these slopes occur only as narrow bands parallel with the streams. Because of the steep topography that dominates Marshall County, hillside creep and geologic erosion have been active, and the formation of deep soils with mature, strongly developed horizons has been inhibited.

The relationship between topography and some of the soils of the county is shown in, figure 9.

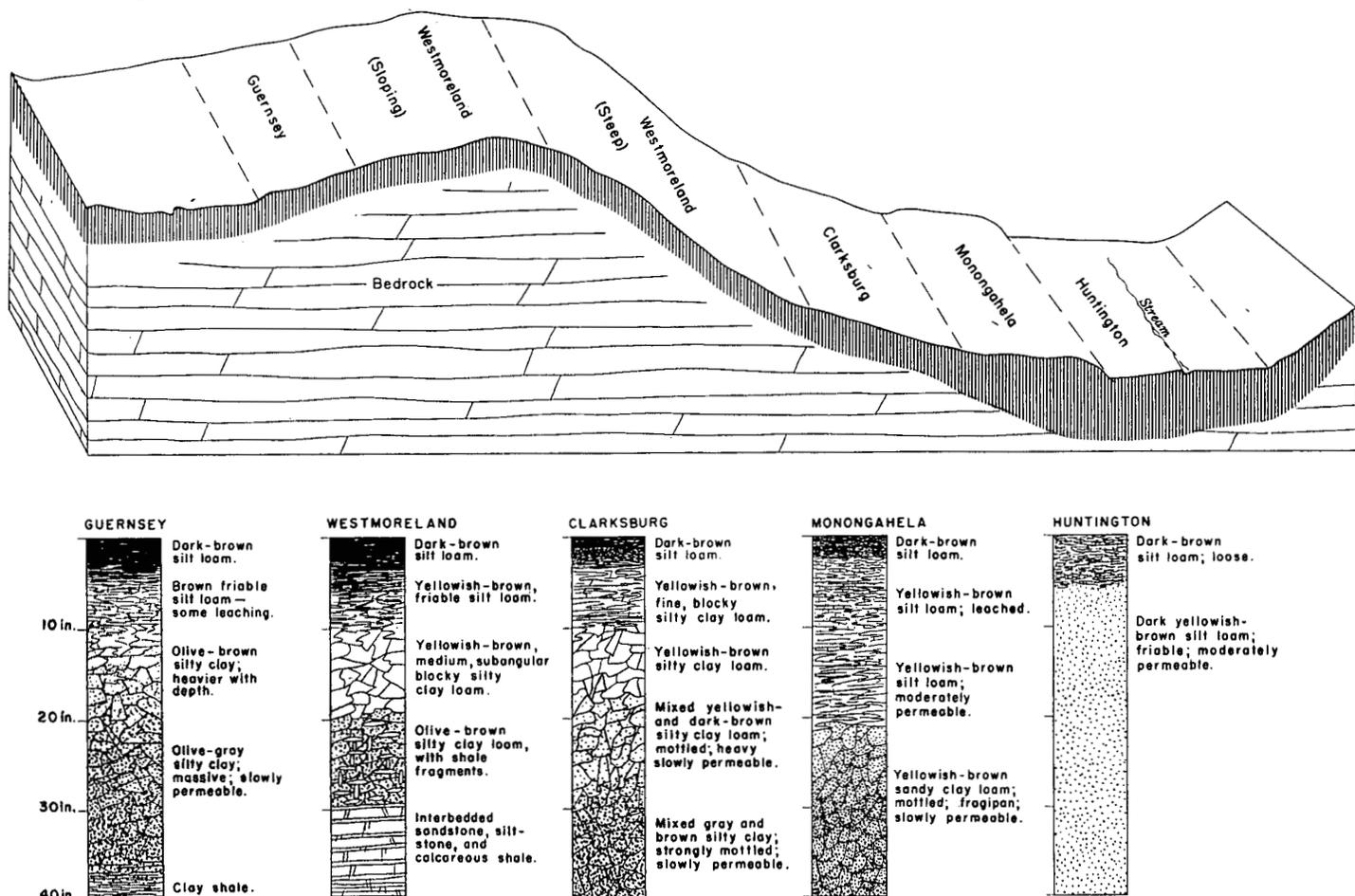


Figure 9.—Relationship between topography and soils.

Living matter

Vegetation, animals, insects, bacteria, fungi, and the like influence the nature of the soil horizons, particularly the surface horizons. Gains in organic matter and nitrogen, gains or losses in plant nutrients, and changes in structure and porosity are the main results of the activity of living matter.

Originally a mixed hardwood forest covered Marshall County. Hardwood trees are deep rooted. They take up minerals from soil depths and deposit them on the surface, mainly in the form of leaf litter. Trees blown down by wind cause some mixing of the upper layers of the soil. Forest cover serves to insulate the soil against sudden temperature changes.

Burrows of small animals, insects, and earthworms help to increase intake of water. Small organisms are active in mixing the organic material with mineral soil.

Time

The soils of Marshall County show various stages of maturity. Alluvial soils on the flood plains are young, or immature. They have not developed horizons that can be distinguished with any degree of certainty. Soils on the steep slopes are intermediate in maturity. They are shallow and generally have weak, or distinct but not prominent, horizons. Soil-forming processes have had less time to alter the continually renewed parent material on the steep slopes than they have had to alter parent material on the gentler slopes. In contrast, soils on the terraces, especially those at levels high above stream flow, are examples of old, strongly weathered soils. Here the soil-forming processes have been active for an extremely long time. Truncation of the soils by geologic erosion has been slow, and, consequently, new parent material has been slow to come within reach of soil-forming processes.

Some of the terrace soils offer a clue to changes that may have taken place over a long period. An area of Monongahela soils occurs on the hill just east of Glen Dale, about 500 to 550 feet above the Ohio River. Other areas of this soil occur at approximately the same elevation. The sandy substrata of these soils clearly indicate that the material was deposited by running water—undoubtedly a large stream, judging by the area of these soils. Therefore, these soils, in their youth, were probably much like the Huntington soils that now occur along the river. The strongly developed profile, with a distinct A_2 horizon and a dense, blocky fragipan in the lower B horizon, indicates a long period of time when leaching, eluviation, and other soil-forming processes have been active.

Classification of Soils

Great soil groups

On the average farm in Marshall County, there are generally five or six soil series. In the county as a whole, there are 18 series. In West Virginia, the number is nearly a hundred, and in the United States, it is in the thousands. Since no one can keep the characteristics of so many soil series in mind, it is useful to group them into broad classes to show which are similar and how one is related to another.

The most widely used broad category for grouping soil series in this country is the great soil group (6). Although

the soil series of this country number in the thousands, less than 60 great soil groups have been recognized. By knowing the main features of a great soil group, it is possible to have a general picture of each of the component series. Furthermore, it is easier to compare the soils in Marshall County with those in other parts of the country by using great soil groups.

A great soil group consists of many series that have major profile characteristics in common. All members of a great soil group have the same kinds of major horizons, although these horizons will not be exactly the same in every profile. For example, a major horizon may be faint in some soils and prominent in others within the same great soil group.

Marshall County lies near the southern edge of the region dominated by the great soil group known as Gray-Brown Podzolic soils. The region in which such soils are dominant has a cool, moist climate and an original forest cover consisting mainly of deciduous hardwoods with a few conifers. Some of the soils have features common to the Red-Yellow Podzolic group—a major group in the humid, warm-temperature region of the southeastern United States. A few of the soils in the county are placed in the Red-Yellow Podzolic group.

Some of the agriculturally important soils in Marshall County have been formed in flood plains of streams, where the sediments have been in place a relatively short time. These lack some of the definitive horizons of the Gray-Brown Podzolic group and are consequently classified as Alluvial soils, a third great soil group in Marshall County.

Less important and less extensive is a fourth great soil group known as Regosols. These soils formed in very sandy deposits where parent materials restrict the differentiation of horizons.

A fifth group comprises wet soils that occur in depressed areas or in flats receiving excess water. These bear the marks of poor drainage in their morphology and are classified as Low-Humic Gley soils.

The classification of soil series in Marshall County is given in table 12. Along with the classification of soil series into great soil groups is information on the nature of soil parent materials, topographic position, relative depth, and drainage.

GRAY-BROWN PODZOLIC SOILS

Soils of this group have relatively thin organic-mineral A_1 horizons, moderately leached, lighter colored A_2 horizons, over darker B horizons with moderate increases in clay as compared to the A and C horizons. The degree of horizonation is evident to distinct on the whole, but the extent of weathering and leaching has been moderate. As compared to Red-Yellow Podzolic soils, those of the Gray-Brown Podzolic group are less weathered and leached and generally have higher base status. Weathering processes are not as far advanced in Gray-Brown Podzolic soils as in Red-Yellow Podzolic soils.

The Westmoreland, Brooke, Gilpin, Wheeling, Guernsey, Brookside, Clarksburg, Captina, Wyatt, Upshur, and Ashton series are classified as Gray-Brown Podzolic soils.

The Westmoreland, Brooke, Gilpin, and Upshur soils occur mostly in hilly landscapes. Because of the hilly topography, the soils have shallower profiles than are characteristic of Gray-Brown Podzolic soils. For example, the

TABLE 12—Soil series classified by great soil groups, and the parent materials, topographic position, drainage, and depth of each series

GRAY-BROWN PODZOLIC SOILS						
Parent material	Topographic position	Well drained (shallow to moderately deep)	Well drained (deep)	Moderately well drained (deep)	Somewhat poorly drained (deep)	Poorly drained (deep)
Interbedded siltstone, sandstone, acid and alkaline gray shale, and limestone.	Uplands.....	Westmoreland.....		Guernsey.....		
Limestone.....	Uplands.....	Brooke.....				
Gray acid sandstone and shale.....	Uplands.....	Gilpin ¹				
Red, alkaline clay shale.....	Uplands.....	Upshur.....				
Material from Brooke, Westmorelands and Gilpin-Upshur uplands.	Colluvial slopes.....		Brookside.....	Clarksburg.....		
Material from—						
Alkaline slack-water deposits.....	Terraces.....				Wyatt.....	
Lime-influenced uplands.....	Terraces.....		Ashton ²	Captina.....		
Glacial outwash.....	Terraces.....		Wheeling ¹			
RED-YELLOW PODZOLIC SOILS						
Material from residual acid uplands.	Terraces.....		Holston.....	Monongahela.....		
REGOSOLS						
Windblown sandy deposits.....	Terraces.....		Lakin.....			
LOW-HUMIC GLEY SOILS						
Material from lime-influenced uplands.	Terraces.....					Robertsville.
Material from lime-influenced uplands.	Flood plains.....					Melvin.
ALLUVIAL SOILS						
Material from lime-influenced uplands.	Flood plains.....		Huntington.....	Lindside.....		

¹ An intergrade to Red-Yellow Podzolic soils.² An intergrade to Alluvial soils.

horizons are all thinner in Westmoreland soils, formed on strongly sloping sites, than in the Brookside soils, formed on gently sloping sites.

The Gilpin and Wheeling soils have lower base status than typical for the Gray-Brown Podzolic group. On the other hand, the profile colors are similar to those of typical Gray-Brown Podzolic soils. Thus, these two series have some characteristics of Gray-Brown Podzolic soils combined with a few characteristics of Red-Yellow Podzolic soils. On the basis of morphology and the moderate base status, these two series are classified as Gray-Brown Podzolic soils but are considered as intergrading to the Red-Yellow Podzolic group.

The Brooke and Upshur soils have A₂ horizons that are less leached and B horizons that have more clay than other Gray-Brown Podzolic soils in Marshall County. The larger amounts of clay in the B horizon and, perhaps, the less thorough leaching of the profile seem due to the fine texture of the parent materials. The red colors of Upshur soils are inherited from the parent shales.

Captina and Wyatt soils are less well drained than other

Gray-Brown Podzolic soils in the county. This is reflected in the occurrence of mottling near the surface and in dull colors in the deeper horizons. The Wyatt soils are somewhat poorly drained. They are wetter than typical for Gray-Brown Podzolic soils and, therefore, are considered intergrades to the Low-Humic Gley group.

The Ashton soils have less distinct horizonation than is characteristic of the Gray-Brown Podzolic group. They were formed in alluvial sediments on low terraces or high bottom lands that are not far above normal floods. Consequently, horizon differentiation has made some, although little, progress. Ashton soils are included in the Gray-Brown Podzolic group but are thought to be intergrades to the Alluvial group.

The profile of Westmoreland silt loam that represents the Gray-Brown Podzolic group is described in the section Descriptions of Soil Series and Mapping Units.

RED-YELLOW PODZOLIC SOILS

Soils of this group have thin organic-mineral A₁ horizons, light-colored, strongly leached A₂ horizons, and B

horizons that are red, yellowish-red, or yellow and have more clay than the A₂ horizons. The B horizons grade downward to parent materials that are commonly siliceous. The soils are acid throughout their profiles. The Red-Yellow Podzolic soils are considered more advanced in weathering than the Gray-Brown Podzolic soils. The more distinct A₂ horizons and the colors of redder hue or higher chroma are considered direct reflections of this more intense weathering. Colors indicate more accumulation of sesquioxides in the profile. On the whole, Red-Yellow Podzolic soils have lower base status than the Gray-Brown Podzolic soils. Furthermore, it seems that practically all easily weatherable minerals have decomposed and disappeared from Red-Yellow Podzolic soils.

In Marshall County, the Red-Yellow Podzolic group is represented by the Holston and Monongahela series. Both of these soils occur on terraces along large streams. The Holston series is well drained and a typical soil for the group. The Monongahela soils are not well drained and, therefore, have some characteristics, such as mottling, that are normal to Low-Humic Gley soils. The A₂ horizons of these soils are not as gray as is typical for Red-Yellow Podzolic soils.

A profile description that illustrates the Red-Yellow Podzolic group is that of Monongahela silt loam. It is given in the section Descriptions of Soil Series and Mapping Units.

REGOSOLS

Regosols are deep, unconsolidated deposits of mineral materials with little or no horizon differentiation.

Lakin loamy sand is the only soil of this group in Marshall County. It occupies a very small area (about a hundred acres) and is of little importance agriculturally. It has very little profile development. There is a faint color contrast between surface layers and the underlying material. The occasional thin lenses, with a very slight increase in clay, indicate a very weak, discontinuous development of the B horizon.

A profile description of Lakin loamy sand is given in the section Descriptions of Soils Series and Mapping Units.

LOW-HUMIC GLEY SOILS

Soils of this group have a thin, dark-gray surface soil, a grayish-brown or gray A₂ horizon, and a strongly mottled silty clay loam or silty clay B horizon. They have developed under wet conditions. Fluctuating and generally high water tables cause poor aeration in these soils, especially during winter and spring.

In Marshall County, the soils classified in the Low-Humic Gley group are of the Robertsville and Melvin series. Profile descriptions for Robertsville silt loam and Melvin silt loam are given in the section Descriptions of Soil Series and Mapping Units.

ALLUVIAL SOILS

Alluvial soils consist of material deposited by floodwaters in relatively recent times. They are so young that they have not developed distinct horizons.

In Marshall County, the Huntington and Lindsides are classified as Alluvial soils. Profile descriptions of Huntington silt loam and of Lindsides silt loam are given in the section Descriptions of Soil Series and Mapping Units.

The Soils of Marshall County

The soils and miscellaneous land types of Marshall County are shown on the soil map at the back of this report. To understand these soils, it will be necessary to learn some of the terms used in describing them. The first part of this section provides these definitions. In the pages following these definitions, the soil series and the soils in each of these series are described.

Soil Survey Methods and Definitions

The scientist who makes a soil survey examines the soils in the field, classifies them according to the facts observed, maps their boundaries on an aerial photograph or other map, and describes them in his report.

The soil scientist bores or digs many holes to see what the soils are like. The holes are not spaced in a regular pattern; they are located according to the lay of the land. Most of them are not more than a quarter of a mile apart, and some are much closer. In most soils each boring, or hole, reveals several distinct layers, called horizons, which collectively are known as the soil profile. Each layer is studied to see how it differs from others in the profile and to learn things about the soil that will affect its capacity to support plant growth.

CLASSIFICATION.—On the basis of the characteristics observed by the survey team or determined by laboratory tests, soils are classified by phases, types, and series.

Soil type.—Soils similar in kind, thickness, and arrangement of soil layers and in the texture of the surface layer are classified as one soil type.

Soil phase.—Because of differences other than those of kind, thickness, and arrangement of layers, some soil types are divided into two or more phases. Slope variations, frequency of rock outcrops, degree of erosion, depth of soil over the substratum, stoniness, or natural drainage are examples of characteristics that suggest dividing a soil type into phases.

The soil phase (or the soil type if it has not been subdivided) is the unit shown on the soil map. It is the unit that has the narrowest range of characteristics. Use and management practices, therefore, can be specified more easily than for soil series or yet broader groups that contain more variation.

Soil series.—Two or more soil types that differ in texture of the surface layer but are otherwise similar in kind, thickness, and arrangement of soil layers are normally designated as a soil series. In a given area, however, a soil series may be represented by only one soil type. Each series is named for a place near which it was first mapped.

Miscellaneous land types.—Areas that have little true soil are not classified by types and series. Instead, they are identified by descriptive names such as Made land (Mc) and Mine dumps (Mc).

Soil complex.—When small areas of two or more soils are so intricately associated that it is not feasible to show them separately on the map, they are mapped together and called a soil complex. Gilpin-Upshur silty clay loams, 3 to 10 percent slopes, is a complex mapped in Marshall County.

Descriptions of Soil Series and Mapping Units

This subsection is provided for those who want detailed information about the soils. It describes the series and mapping units in the county. The mapping units are the areas on the detailed soil map at the back of this report. They are bounded by lines and identified by a letter symbol. For more generalized information about soils, the reader can refer to the section Soils of the County in General, in which the broad patterns of soils are explained.

In this subsection the soil descriptions are arranged in alphabetical order by series name. Each soil series is described, as well as a soil profile representative of the series. The thickness, color, texture, structure, consistency, and nature of the lower boundary are given for most horizons of the profile. Other characteristics that apply to a particular horizon are also given. The colors used

in the profile description refer to moist soil unless otherwise indicated. The symbols in parentheses, such as (10YR 4/4), are color notations, which are used to describe color precisely. All soils in one series have essentially the same kind of profile. The differences, if any, are explained.

Following the name of each soil, or mapping unit, is the symbol used to identify that soil on the detailed soil map. The capability unit is given for each soil. Further information on use and management of a soil may be found in the subsection Capability Units.

The approximate acreage and proportionate extent of the soils are given in table 13. It will be helpful to refer to the subsection Soil Survey Methods and Definitions, where series, type, phase, and other special terms used in describing soils are listed.

TABLE 13.—Approximate acreage and proportionate extent of soils mapped

Soil	Area	Extent	Soil	Area	Extent
	<i>Acres</i>	<i>Percent</i>		<i>Acres</i>	<i>Percent</i>
Ashton silt loam, 0 to 3 percent slopes	321	0.2	Guernsey silt loam, 3 to 10 percent slopes	121	.1
Ashton silt loam, 3 to 12 percent slopes	142	.1	Guernsey silt loam, 10 to 20 percent slopes	387	.2
Brooke silty clay loam, 8 to 20 percent slopes	227	.1	Guernsey silt loam, 20 to 30 percent slopes, severely eroded	525	.3
Brooke silty clay loam, 20 to 40 percent slopes	94	(¹)	Holston silt loam, 2 to 8 percent slopes	405	.2
Brookside silt loam, 3 to 8 percent slopes	207	.1	Holston silt loam, 8 to 15 percent slopes	481	.2
Brookside silt loam, 8 to 15 percent slopes	643	.3	Holston silt loam, 15 to 25 percent slopes	92	(¹)
Brookside silt loam, 15 to 25 percent slopes	1,071	.5	Huntington fine sandy loam, 0 to 3 percent slopes	784	.4
Brookside silt loam, 15 to 25 percent slopes, severely eroded	565	.3	Huntington silt loam, 0 to 3 percent slopes	4,295	2.2
Brookside silt loam, 25 to 35 percent slopes	443	.2	Huntington silty clay loam, 0 to 3 percent slopes	160	.1
Brookside silt loam, 25 to 35 percent slopes, severely eroded	548	.3	Lakin loamy sand, 10 to 20 percent slopes	92	(¹)
Captina silt loam, 3 to 8 percent slopes	92	(¹)	Lindside silt loam, 0 to 3 percent slopes	1,383	.7
Clarksburg silt loam, 3 to 8 percent slopes	27	(¹)	Melvin silt loam, 0 to 3 percent slopes	395	.2
Clarksburg silt loam, 8 to 15 percent slopes	274	.1	Monongahela silt loam, 2 to 8 percent slopes	564	.3
Clarksburg silt loam, 15 to 25 percent slopes	132	.1	Monongahela silt loam, 8 to 15 percent slopes	199	.1
Clarksburg silt loam, 15 to 25 percent slopes, severely eroded	246	.1	Robertsville silt loam, 0 to 5 percent slopes	79	(¹)
Gilpin silt loam, 3 to 10 percent slopes	198	.1	Westmoreland silt loam, 3 to 10 percent slopes	976	.5
Gilpin silt loam, 10 to 20 percent slopes	1,281	.7	Westmoreland silt loam, 10 to 20 percent slopes	12,791	6.5
Gilpin silt loam, 20 to 30 percent slopes	1,329	.7	Westmoreland silt loam, 10 to 20 percent slopes, severely eroded	512	.3
Gilpin silt loam, 20 to 30 percent slopes, severely eroded	1,233	.6	Westmoreland silt loam, 20 to 30 percent slopes	13,189	6.7
Gilpin silt loam, 30 to 40 percent slopes	1,358	.7	Westmoreland silt loam, 20 to 30 percent slopes, severely eroded	11,192	5.7
Gilpin silt loam, 30 to 40 percent slopes, severely eroded	3,700	2.0	Westmoreland silt loam, 30 to 40 percent slopes	7,434	3.8
Gilpin silt loam, 40 to 55 percent slopes	816	.4	Westmoreland silt loam, 30 to 40 percent slopes, severely eroded	15,724	8.0
Gilpin silt loam, 40 to 55 percent slopes, severely eroded	692	.4	Westmoreland silt loam, 40 to 55 percent slopes	31,087	15.9
Gilpin-Upshur silty clay loams, 3 to 10 percent slopes	160	.1	Westmoreland silt loam, 40 to 55 percent slopes, severely eroded	5,031	2.6
Gilpin-Upshur silty clay loams, 10 to 20 percent slopes	2,982	1.5	Wheeling sandy loam, 0 to 3 percent slopes	104	.1
Gilpin-Upshur silty clay loams, 10 to 20 percent slopes, severely eroded	140	.1	Wheeling sandy loam, 3 to 10 percent slopes	178	.1
Gilpin-Upshur silty clay loams, 20 to 30 percent slopes	4,253	2.2	Wheeling silt loam, 0 to 3 percent slopes	208	.1
Gilpin-Upshur silty clay loams, 20 to 30 percent slopes, severely eroded	4,832	2.5	Wheeling silt loam, 3 to 10 percent slopes	262	.1
Gilpin-Upshur silty clay loams, 20 to 30 percent slopes, very severely eroded	205	.1	Wyatt silt loam, 3 to 8 percent slopes	57	(¹)
Gilpin-Upshur silty clay loams, 30 to 40 percent slopes	2,904	1.5	Wyatt silt loam, 15 to 30 percent slopes	56	(¹)
Gilpin-Upshur silty clay loams, 30 to 40 percent slopes, severely eroded	12,239	6.3	Made land	2,625	1.3
Gilpin-Upshur silty clay loams, 30 to 40 percent slopes, very severely eroded	198	.1	Mine dumps	189	.1
Gilpin-Upshur silty clay loams, 40 to 55 percent slopes	30,154	15.4	Miscellaneous (roads, water, and other areas)	3,390	1.7
Gilpin-Upshur silty clay loams, 40 to 55 percent slopes, severely eroded	7,167	3.7			
			Total	195,840	100.0

¹ Less than 0.1 percent.

Ashton series

The Ashton are deep, well-drained alluvial soils on high bottoms above the normal overflow level. These soils have developed from alluvium that washed from upland soils influenced by limestone. They are not extensive and occur mainly along the Ohio River. Some areas are along Wheeling and Fish Creeks. The Ashton soils are similar to the Huntington soils. Normally, they occupy areas that are adjacent to those soils but 2 to 6 feet above them. They are firmer and have a more strongly developed profile than the Huntington soils. They also differ in having a weak- to moderate-textured B horizon with blocky structure.

Representative profile (Ashton silt loam on slopes of 0 to 3 percent in a cultivated field along the Ohio River near McMechen):

- A_p 0 to 10 inches, dark-brown (10YR 3/3) silt loam; weak, fine, granular structure; loose; medium acid; gradual boundary; 8 to 15 inches thick.
- B₁ 10 to 22 inches, dark yellowish-brown (10YR 4/4) loam; weak, fine, subangular blocky structure; friable; medium acid; gradual boundary; 9 to 15 inches thick.
- B₂ 22 to 38 inches +, dark yellowish-brown (10YR 4/4) sandy clay loam; weak, medium, subangular blocky structure; slightly firm; clay coating on a few peds; few roots; medium acid.

Range in characteristics: The surface texture ranges from loam to silt loam, and the subsoil from loam to silty clay loam. Some areas are loam throughout the profile.

Topography: Nearly level bottom land.

Drainage: Well drained.

Permeability: Moderate.

Use and management: The Ashton soils are excellent for all uses. Their natural productivity is the highest in the county. During extremely severe floods, these soils are covered with water.

Ashton silt loam, 0 to 3 percent slopes (A_c).—If good till and fertility are maintained through good soil management, this soil can be used for row crops almost continuously. It is well suited to truck farming. Capability unit I-6.

Ashton silt loam, 3 to 12 percent slopes (A_b).—Because of irregular and gently rolling slopes, this soil cannot be used as intensively as Ashton silt loam, 0 to 3 percent slopes. It is suited to the crops commonly grown in the county, but conservation practices are needed to keep it permanently productive. Capability unit IIe-6.

Brooke series

The Brooke series consists of deep, well-drained soils of the uplands. The soils have developed from massive, gray limestone and gray, calcareous shale. They occur in small areas on many of the rounded ridgetops and on benches or saddles between the ridgetops in the Westmoreland area. The Brooke soils are low in phosphorus but high in potassium and lime.

Representative profile (Brooke silty clay loam on a slope of 8 to 20 percent in a pastured field on Roberts Ridge):

- A_p 0 to 5 inches, dark-brown (7.5YR 3/2) silty clay loam; weak, fine, blocky and fine, granular structure; firm when moist, hard when dry; many fine roots and wormholes; slightly acid; a few olive-colored weathered limestone fragments; clear boundary; 3 to 7 inches thick.

A₁ 5 to 10 inches, dark reddish-brown (5YR 3/3) silty clay loam; peds are dark reddish brown on outside but dark reddish gray (5YR 4/2) when crushed; weak, coarse, blocky structure; slightly plastic and sticky; many fine pores; faint clay films on ped surfaces and cracks; slightly acid; gradual boundary; 4 to 8 inches thick.

B₁ 10 to 20 inches, dark-brown (7.5YR 4/2) clay; a few, faint brown spots; moderate, medium, blocky structure; aggregates are arranged in weak prisms; firm when moist, hard when dry, and very plastic when wet; many fine pores; clay coats on peds; slightly acid; gradual boundary; 8 to 15 inches thick.

C 20 to 40 inches +, mixed olive (5YR 5/3), light olive-brown (2.5Y 5/4 to 5/6), dark reddish-brown, and black slightly gritty clay; massive structure; hard when dry, firm when moist, and sticky and plastic when wet; clay accumulation in cracks and holes; manganese coats on some surfaces; slightly acid; 5 to 10 percent consists of weathered fine fragments of shale and siltstone.

Range in characteristics: The depth to hard, gray limestone varies. Brooke soils are generally more shallow to parent material on the rounded knobs. The color of the surface soil ranges from brown to very dark brown. Small limestone boulders are on the surface in places.

Topography: The Brooke soils occur on benches and ridgetops. The dominant slopes are about 18 percent, but slopes range from 8 to 40 percent.

Drainage: Well drained.

Permeability: Slow.

Use and management: The high natural fertility of the Brooke soils makes them well suited to grasses and legumes. They are difficult to plow in the summer and fall, and, if not protected, they erode severely. They are used mainly for hay.

Brooke silty clay loam, 8 to 20 percent slopes (B_c).—This soil is slow to take up water and is difficult to plow. Erosion control is needed. Because of its high natural fertility, this soil is excellent for hay and pasture. Capability unit IIIe-30.

Brooke silty clay loam, 20 to 40 percent slopes (B_b).—More small limestone boulders occur on this soil than on the more gently sloping soil. Because of the steep slopes, this soil should be kept in close-growing crops, pasture, or woodland. Capability unit IVe-1.

Brookside series

The Brookside series consists of deep, well-drained soils on colluvial material derived from limestone, acid sandstone, and alkaline and acid shale. These soils occur along the Ohio River and Wheeling, Fish, and Grave Creeks. They are in the Westmoreland and Gilpin-Upshur soil areas.

Representative profile (Brookside silt loam on slopes of 8 to 15 percent in an idle field along Wheeling Creek):

A_p 0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, fine, granular structure; friable; strongly acid; clear boundary; 6 to 10 inches thick.

B₁ 7 to 12 inches, yellowish-brown (10YR 5/4) silty clay loam; moderate, fine, subangular blocky structure; friable when moist, slightly plastic when wet; faint clay coats on surface of peds; strongly acid; clear boundary; 3 to 8 inches thick.

B₂ 12 to 28 inches, grayish-brown (10YR 5/2) silty clay with many faint mottles of dark brown; peds grayish brown on outside but yellowish brown (10YR 5/4) when crushed; strong, medium and coarse, subangular blocky structure; friable when moist but

slightly sticky and plastic when wet; many fine pores; clay coats on peds distinct; strongly acid; clear boundary; 12 to 20 inches thick.

- B₂ 28 to 40 inches +, brown (10YR 5/3) silty clay; peds brown on outside because of clay coats but yellowish brown to dark yellowish brown (10YR 5/4 to 4/4) on inside; light olive brown (2.5Y 3/3) is dominant color of soil material at 40 inches; weak, coarse, prismatic structure tends to break to coarse, platy; firm; strongly acid; manganese coatings on some peds and in cracks.

Small stone fragments are scattered throughout the profile. Gravity and water have moved soil material down the slope and mixed it. Some areas have a few sandstone boulders on the surface.

Range in characteristics: Some of the acreage in this series has a dark reddish-brown subsoil. This variant occurs in the southern part of the county in association with Gilpin-Upshur soils. The subsoil ranges from yellowish brown to grayish brown. The range in acidity in this series is from strongly acid to slightly acid. The areas of the less acid soil occur mostly at the base of steeper slopes, and normally they are in narrower bands than the areas of more acid soil.

Topography: The dominant slope range is from 12 to 25 percent, but the full range is from 3 to 35 percent. The soils occur as bands around the lower part of hill-sides and as fan-shaped areas at the heads of streams. They are generally cut by ravines and are somewhat hummocky.

Drainage: Well drained; some seep spots and small moderately well drained areas are included.

Permeability: Moderate to slow.

Use and management: A deep profile, good drainage, and good natural fertility make these soils productive. Cultivation is impeded on these soils because they occur in narrow bands and have an uneven surface in many places. If Brookside soils are used for small grains and row crops, intensive management is needed to control erosion. Stripcropping is needed for erosion control but is difficult on many areas because of ravines. In many places diversion ditches or terraces are needed to intercept runoff from the higher slopes.

Brookside silt loam, 3 to 8 percent slopes (Bc).—The small areas of this soil normally are managed with adjacent soils. Ravines and hummocky surface caused by soil slips are not very common on this gently sloping soil. The crops commonly grown in the county are suited to this soil if erosion is controlled. Capability unit IIe-11.

Brookside silt loam, 8 to 15 percent slopes (Bd).—This soil can be used for all the crops ordinarily grown. Because it occurs in small areas and narrow bands and is cut by ravines, it is of limited value for row crops. Stripcropping is needed to control erosion but is difficult because of relief. Capability unit IIIe-11.

Brookside silt loam, 15 to 25 percent slopes (Be).—This soil is suitable for the row crops commonly grown; but, because of erosion, it is more suitable for permanent hay or pasture. Erosion is difficult to control on this moderately steep soil. Capability unit IVe-1.

Brookside silt loam, 15 to 25 percent slopes, severely eroded (Bf).—Erosion has removed most of the surface layer from this soil. The plow layer now consists of remnants of the original silt loam surface soil mixed with the

upper part of the heavy, clayey subsoil. It is, therefore, poorer in tilth and more erodible than the plow layer of the less eroded Brookside silt loams on the same slopes. Slips, deep gullies, and loss of the original surface soil limit the use. This soil needs more intensive management and erosion control than Brookside silt loam, 15 to 25 percent slopes. Capability unit IVe-1.

Brookside silt loam, 25 to 35 percent slopes (Bg).—Because of the risk of erosion, this sloping soil is best used for permanent pasture. It has too many ravines and is too steep and hummocky for cropland. Capability unit VIe-3.

Brookside silt loam, 25 to 35 percent slopes, severely eroded (Bh).—Slips, gullies, and severe erosion limit the use of this soil to woods or pasture. If used for pasture, it must be carefully managed. Capability unit VIe-3.

Captina series

The Captina series consists of deep, moderately well drained soils on stream terraces. The soils have developed from old alluvial sediments washed from soils formed on slightly alkaline sandstone and shale. There is a weak fragipan layer at about 20 inches. The Captina soils occur along Wheeling Creek.

Only one soil in the Captina series has been mapped in the county.

Representative profile (Captina silt loam in a meadow on 3 to 8 percent slopes along Wheeling Creek):

- A_p 0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, coarse, granular structure; friable; thin coats of organic matter on peds; slightly acid; boundary abrupt; 7 to 10 inches thick.
- A₂ 8 to 12 inches, dark-brown (10YR 4/3) silt loam; more yellow when crushed; moderate, medium and fine, blocky structure, tending to platy; friable; root channels are filled with A_p material, and walls are commonly coated with organic matter; medium acid; boundary clear; 3 to 6 inches thick.
- B₂₁ 12 to 19 inches, yellowish-brown (10YR 5/4) silty clay loam; surface of peds brown (10YR 4/3); strong, medium and coarse, subangular blocky structure; slightly firm when moist, slightly plastic when wet; clay coats on peds distinct; medium acid; boundary clear; 5 to 10 inches thick.
- B₂₂ 19 to 30 inches, dark yellowish-brown (7.5YR 4/4), light silty clay loam with many mottles of grayish brown (2.5Y 5/3) and dark brown (7.5YR 4/2); moderate, coarse, blocky structure, aggregates arranged in weak, large prisms; firm when moist, slightly plastic when wet; clay coats are distinct; mica fragments in some peds; few fine pores; medium acid; clear boundary; 8 to 15 inches thick.
- C 30 inches +, silty clay loam mottled with yellowish brown, brown, and gray; much mica; some dark manganese concretions; friable when moist; medium acid.

Range in characteristics: Depth to mottling ranges from 18 to 26 inches. The acidity ranges from strongly acid to slightly acid.

Topography: Nearly level to moderately sloping terrace above present level of flood plain. Slopes are mainly less than 5 percent.

Drainage: Moderately well drained.

Permeability: Slowly permeable in fragipan.

Use and management: The natural fertility of these soils is about average for the county. Deep-rooted legumes do not grow well on these soils during wet seasons. Captina soils are sometimes slow to dry and to become firm in spring.

Captina silt loam, 3 to 8 percent slopes (Ca).—This soil has gentle slopes and erosion is slight. It can be used for all crops grown in the county. Simple conservation practices and good soil management are needed to control erosion and to maintain good tilth and fertility. Capability unit IIe-14.

Clarksburg series

The Clarksburg series consists of deep, moderately well drained colluvial soils. These soils are characterized by a claypan at 18 to 24 inches. They were derived from limestone, acid sandstone, and alkaline and acid shale. They are principally in the Westmoreland soil area. These soils differ from the Brookside soils in having poorer drainage.

Representative profile (Clarksburg silt loam on slopes of 8 to 15 percent in an idle field along Wheeling Creek):

- A_p 0 to 8 inches, dark grayish-brown (10YR 4/3) silt loam; moderate, medium, granular structure; friable; strongly acid; many fine roots; clear boundary; 5 to 10 inches thick.
- B₂ 8 to 17 inches, yellowish-brown (10YR 5/6) silty clay loam; moderate, fine and medium, subangular blocky structure; slightly firm; many fine pores and some fine roots; discontinuous coat of clay on peds; strongly acid; gradual boundary; 6 to 12 inches thick.
- B_{2g} 17 to 25 inches, yellowish-brown (10YR 5/6) silty clay loam; many distinct gray-brown (2.5Y 5/2) and strong-brown (7.5YR 5/6) mottles; weak, coarse, subangular blocky structure, somewhat massive; slightly plastic when wet, hard when dry; some fine pores; clay coats on peds and rock faces; strongly acid; gradual boundary; 6 to 10 inches thick.
- B_{2g} 25 to 60 inches +, silty clay with many and distinct mottles of gray brown (2.5Y 5/2) and strong brown (7.5YR 5/6); massive structure; very hard when dry, slightly plastic when wet; few fine pores; many faces coated with manganese; slightly acid.

Small stone fragments occur throughout the profile. Gravity and water have moved soil material down the slope and mixed it.

Range in characteristics: Depth to the slowly permeable zone ranges from 18 to 24 inches. The proportions of clay shale and sandstone in the parent material determine whether this slowly permeable zone is a brittle fragipan or a plastic claypan. The Clarksburg soils range from strongly acid to slightly acid.

Topography: The dominant slope range is 10 to 25 percent, but the full range is 3 to 25 percent. The soils occur as bands around the lower part of hillsides and as fan-shaped areas at the heads of streams. The surface is often uneven and broken by ravines.

Drainage: Moderately well drained. Seep spots are common on these soils.

Permeability: Slow.

Use and management: These soils have above average natural fertility and hold moisture well. They normally become warm late in spring and tend to puddle if worked when too wet. Their use for deep-rooted legumes is somewhat limited because of the slowly permeable zone at 18 to 24 inches. Many areas of these soils are small and must be managed with adjacent soils.

Clarksburg silt loam, 3 to 8 percent slopes (Cb).—This soil occurs in small areas and is generally managed with soils on adjacent slopes. It is suited for the production of crops commonly grown in the county if erosion control and other good management are used. Good natural fer-

tility and high capacity to hold available moisture make this soil well suited to hay and pasture. An occasional seep spot may need artificial drainage. Capability unit IIe-14.

Clarksburg silt loam, 8 to 15 percent slopes (Cc).—This soil is suited to the production of most crops commonly grown in the county. Because this soil is hummocky in many places and is cut by ravines, it has limited value for row crops. Good management that includes erosion control is needed to keep this soil permanently productive. Capability unit IIIe-14.

Clarksburg silt loam, 15 to 25 percent slopes (Cd).—Erosion may be severe on this soil unless controlled. Strip-cropping is needed to control erosion on cultivated areas, but the relief in many places is not suitable for that practice. Because of the slope and the risk of erosion, this soil is most suitable for long-term hay and pasture. Capability unit IVe-9.

Clarksburg silt loam, 15 to 25 percent slopes, severely eroded (Ce).—Erosion has removed most of the surface layer from this soil. The plow layer now consists of heavy clayey subsoil and is low in organic matter, has poor tilth, and absorbs moisture slowly. This soil requires erosion control. It needs more intensive management than the less eroded Clarksburg silt loam, 15 to 25 percent slopes. Its use is limited by slips, deep gullies, and loss of the original surface soil. This soil is mostly around barn lots where livestock trample it much of the year. Capability unit IVe-9.

Gilpin series

The Gilpin series consists of moderately deep, well-drained soils of the uplands. These soils have developed from interbedded acid gray sandstone, siltstone, and shale. They are mainly on the hills around Cameron. There are some Gilpin soils in other parts of the county in association with Westmoreland and Upshur soils.

Representative profile (Gilpin silt loam on a slope of about 15 percent in a wooded area 1 mile southwest of Cameron):

- A_p 0 to 9 inches, dark-brown (10YR 4/3) silt loam; weak, fine, granular structure; friable; many fine tree roots; strongly acid; abrupt boundary; 4 to 10 inches thick.
- A₂ 9 to 13 inches, yellowish-brown (10YR 5/4) silt loam; weak, medium, platy structure; friable; many roots; 5 to 10 percent consists of hard shale fragments; strongly acid; clear boundary; 3 to 5 inches thick.
- B₂ 13 to 22 inches, yellowish-brown (10YR 5/4), light silty clay loam; weak, medium, subangular blocky structure, tending to platy; loose, friable; clay films on ped faces and in pores; 15 to 20 percent consists of angular shale fragments ½ to 2 inches in diameter; strongly acid; gradual boundary; 6 to 12 inches thick.
- B₃ 22 to 25 inches, strong-brown (7.5YR 5/6) and yellowish-brown (10YR 5/6), shaly silt loam; weak, medium, subangular blocky structure, tending to platy; clay coats on ped faces and rock fragments; 50 percent consists of shale fragments; strongly acid; gradual boundary; 3 to 9 inches thick.
- D_r 25 inches +, olive (5Y 4/3 to 5/4) weathered siltstone and fine-grain sandstone; some fragments coated with silt and clay; many coated with manganese and iron.

Range in characteristics: These soils range from about 18 to 36 inches in depth, but small areas of deeper soils are included. On the lower slopes, the soil profile is thicker. Where the Gilpin soils are influenced by red shale, the subsoil is heavier and the surface soil and subsoil are darker.

Topography: Slopes range from strongly sloping to very steep. The ridgetops are generally rounded and narrow. The saddles between the ridges are also narrow.

Drainage: Well drained.

Permeability: Moderate.

Use and management: The Gilpin soils are used principally for hay and pasture. They are average in fertility and moisture-holding capacity. Because of slope, not many of the Gilpin soils are suited to row crops. Improper use of these soils increases the danger of erosion.

Gilpin silt loam, 3 to 10 percent slopes (Gc).—This soil occurs on the ridgetops. It ranges from about 18 to 36 inches in depth. Most of the deeper soils that are included with the Gilpin soils are in this unit. Gilpin silt loam, 3 to 10 percent slopes, is suited to the production of crops commonly grown in the county. Most areas of this soil are small and must be managed with soils on the surrounding slopes. Capability unit IIe-10.

Gilpin silt loam, 10 to 20 percent slopes (Gb).—This soil is suited to all general farm crops. However, because of the slopes, productivity can be maintained only by good management that includes erosion control. Slopes are smooth and well suited to stripcropping. A few acres of this soil are severely eroded. Capability unit IIIe-10.

Gilpin silt loam, 20 to 30 percent slopes (Gc).—This soil should be kept in permanent vegetation most of the time. Use of row crops reduces the amount of organic matter and makes erosion difficult to control. Capability unit IVe-3.

Gilpin silt loam, 20 to 30 percent slopes, severely eroded (Gd).—This soil has lost most of the topsoil through erosion. The present plow layer is lower in organic matter, absorbs moisture less readily, and has poorer tilth than the less eroded Gilpin silt loam, 20 to 30 percent slopes. To prevent further damage from erosion, the use of this soil should be limited to permanent hay or pasture. The most severely eroded areas should be used for woodland. A few acres of this soil are badly gullied. Capability unit IVe-3.

Gilpin silt loam, 30 to 40 percent slopes (Ge).—Where this soil occurs on the lower two-thirds of the slope, it is somewhat deeper than the representative profile for the series because of some colluvial influence in its development. Because of the steep slopes, this soil is most suitable for permanent pasture or woods. Capability unit VIIe-2.

Gilpin silt loam, 30 to 40 percent slopes, severely eroded (Gf).—Nearly two-thirds of the Gilpin soil on 30 to 40 percent slopes is severely eroded. Most of the topsoil has been lost. The profile of this soil is more shallow than that described as representative for the series. Because of slope and erosion, this soil is best used for woodland. Capability unit VIIe-2.

Gilpin silt loam, 40 to 55 percent slopes (Gg).—This soil is more shallow to bedrock than the gently sloping Gilpin soils. There has also been more mixing of the material weathered from the interbedded shale and sandstone. This soil is best used for woodland because of its steep slopes. Capability unit VIIe-2.

Gilpin silt loam, 40 to 55 percent slopes, severely eroded (Gh).—This soil is shallow and somewhat droughty. Most of the surface soil has been eroded away. This soil is limited to use for woodland because of slope and erosion. Capability unit VIIe-2.

Gilpin-Upshur complex

The Gilpin-Upshur complex consists of moderately deep, well-drained upland soils. These soils developed from interbedded acid gray sandstone, acid gray shale, and alkaline red clay shale. The two soils that make up this complex occur in alternate narrow strips and cannot be mapped or managed separately. They occupy most of the southern third of the county. A few acres of Westmoreland soils occur with Gilpin-Upshur soils.

Representative profiles of the Gilpin and of the Upshur soils are given, respectively, in the discussions of the Gilpin and Upshur series.

Range in characteristics of the complex: Gilpin-Upshur soils vary in color, depth, texture, and acidity. The parent material of these soils occurs in horizontal layers. The thickness of the various layers ranges from a few inches to several feet. Where the soils were derived from a thick layer of gray shale and sandstone, the color of the Gilpin soils is dominant. Where they were derived from a thick layer of red shale, the color of the Upshur soils is dominant. In most places where the horizontal layers of red and gray parent material are less than 20 inches thick, the B horizon is an intermediate color—a reddish brown.

The depth of the A and B horizons on moderately steep to steep slopes ranges from 12 to 24 inches. The weathered C material ranges from 7 to 20 inches in depth and has a very irregular lower boundary. The fine-grained sandstone parent rock is more resistant to weathering than the red or gray shale. This difference in rate of weathering affects the depth of the Gilpin-Upshur soils.

The texture of the surface soil ranges from silt loam to silty clay, and that of the subsoil, from silty clay loam to clay. Lime nodules are in the red shales in places—normally where the thickness of the shale is 3 feet or more. The profile that contains the lime nodules is splotted with purple. In many places, thin, 1- or 2-inch, discontinuous seams of alkaline gray shale are interbedded in thick red shale layers.

The reaction ranges from strongly acid to slightly acid. The nature of the parent material is the determining factor.

Topography: The topography is a complex of ridges, knobs, benches, and steep slopes. The ridgetops are narrow and have steep intervening slopes. The hills are broken somewhat by benches, but the bench-break topography characteristic of these soils is not so prominent as in other counties. The typical Upshur component of the Gilpin-Upshur complex commonly lies near the ridgetops on saddles, knobs, and benches. The valley walls along the Ohio River and Fish Creek are extremely sharp.

Drainage: Well drained.

Permeability: Moderate for the Gilpin component; slow to very slow for the Upshur component.

Use and management: These soils have good natural fertility and are well suited to bluegrass-whiteclover pasture. Because they erode severely and are difficult to work, they must be carefully managed. Slips, slides, and gullies are typical of the landscape where these soils occur.

Gilpin-Upshur silty clay loams, 3 to 10 percent slopes (Gk).—The dominant profile of this mapping unit is much like that representative of the Upshur series. Because this soil is difficult to work, row crops are not suited. However, suitable crops can be grown if erosion is controlled. Capability unit IIe-15.

Gilpin-Upshur silty clay loams, 10 to 20 percent slopes (Gm).—The soils of this mapping unit are suited to all general farm crops if erosion is controlled. They absorb water rather slowly, particularly the red clay areas. Stripcropping and maintenance of organic matter are needed to keep these soils permanently productive. Because of the risk of erosion when these soils are cultivated, permanent pasture or hay is a good use. Capability unit IIIe-15.

Gilpin-Upshur silty clay loams, 10 to 20 percent slopes, severely eroded (Gn).—The profile of the Upshur part of this complex is similar to that described as representative of the Upshur series. However, most of the topsoil has been lost through erosion. As a result, the present plow layer is low in organic matter, absorbs moisture very slowly, and erodes easily. To prevent further damage by erosion, only hay or permanent pasture should be grown on these soils. Capability unit IVe-15.

Gilpin-Upshur silty clay loams, 20 to 30 percent slopes (Go).—Because the soils of this complex are clayey and have steep slopes, they have rapid runoff and are subject to severe erosion. The best use is for hay or permanent pasture. Capability unit IVe-15.

Gilpin-Upshur silty clay loams, 20 to 30 percent slopes, severely eroded (Gp).—The soils of this complex have lost most of the topsoil through erosion. The present plow layer is a mixture of the remaining topsoil and the clayey subsoil. Because the plow layer absorbs moisture so slowly, more soil is lost through runoff than on the less severely eroded Gilpin-Upshur silty clay loams, 20 to 30 percent slopes. To prevent further damage from erosion, these soils should be used only for hay or permanent pasture. Capability unit IVe-15.

Gilpin-Upshur silty clay loams, 20 to 30 percent slopes, very severely eroded (Gr).—This complex is similar to the other two Gilpin-Upshur complexes having 20 to 30 percent slopes. It consists dominantly of red clay shale soil. As a result of poor management, the soils of this complex have lost the original topsoil and have numerous slips and deep gullies. Because these soils are very severely eroded, they are best suited to forest. Under special management, including erosion control, a part of them may be used for permanent pasture. Capability unit VIe-3.

Gilpin-Upshur silty clay loams, 30 to 40 percent slopes (Gs).—The Gilpin and Upshur components of this mapping unit are about equal. Because of slope and susceptibility to erosion, these soils should be kept under permanent cover. Capability unit VIe-3.

Gilpin-Upshur silty clay loams, 30 to 40 percent slopes, severely eroded (Gt).—The topsoil of this complex has been eroded away. As a result the soils have a lower amount of organic matter and finer texture than the less eroded Gilpin-Upshur soils on 30 to 40 percent slopes. Because of steep slopes, severe erosion, and risk of more erosion, use of this complex should be kept principally in permanent vegetation. Capability unit VIe-3.

Gilpin-Upshur silty clay loams, 30 to 40 percent slopes, very severely eroded (Gu).—This complex is similar to the two similar complexes that have 30 to 40 percent slopes, but it is very severely eroded. Bare spots, slips, and deep gullies are characteristic of this mapping unit. The dominant soil of the complex is Upshur silty clay loam. These soils should be used for forest to prevent further erosion. Capability unit VIIe-1.

Gilpin-Upshur silty clay loams, 40 to 55 percent slopes (Gv).—The soils of this complex are shallow and subject to severe erosion. Because of steep slopes, the soil material from the horizontal interbedded sandstone and the red and gray shale has been more mixed in this mapping unit than in those on more gentle slopes. The valley walls along Fish Creek and the Ohio River make up a large part of this unit. The best use is for forest. Capability unit VIIe-1.

Gilpin-Upshur silty clay loams, 40 to 55 percent slopes, severely eroded (Gw).—The steep eroded soils of this complex are shallow and somewhat droughty. Runoff is rapid. Like the less eroded soils on 40 to 55 percent slopes, there is considerable mixing of the parent material. The use of these soils is limited to forest. Capability unit VIIe-1.

Guernsey series

The Guernsey series consists of moderately deep, moderately well drained, upland claypan soils that have developed from alkaline clay shale. These soils occupy some of the upper benches and broader ridgetops in the Westmoreland soil area.

Representative profile (Guernsey silt loam on 3 to 10 percent slopes in a meadow 2 miles north of Cameron) :

- A_p 0 to 9 inches, dark-brown (7.5YR 4/2 to 4/3) silt loam; moderate, medium, granular structure, tending to platy; friable; some wormholes; strongly acid; clear boundary; 5 to 10 inches thick.
- B₁ 9 to 14 inches, brown (10YR 5/3) silty clay; coarse prisms, 3 to 5 inches across, break to moderate, medium, blocky structure; hard when dry, slightly firm when moist, and plastic and slightly sticky when wet; clay coats on peds; strongly acid; gradual boundary; 3 to 8 inches thick.
- B₂ 14 to 23 inches, olive-brown (2.5Y 5/3) silty clay; distinct medium mottles of light gray (5Y 6/1); weak, coarse, prismatic structure; firm when moist, plastic and slightly sticky when wet; clay coats on some peds; strongly acid; gradual boundary; 7 to 12 inches thick.
- C 23 to 42 inches, olive-gray (5Y 5/2 and 4/2) silty clay; faint mottles of light olive brown (2.5Y 5/4 and 5/0); massive structure; plastic and slightly sticky when wet; clay coats on some peds; some mica flakes; slightly acid; clear boundary; 13 to 26 inches thick.
- D_r 42 inches +, olive-brown to dark grayish-brown, weathered, soft shale.

Range in characteristics: Depth to mottling ranges from 15 to 25 inches. Most of the Guernsey soils on the benches have received colluvial material from the Westmoreland soils above. In some places there has been enough to produce a soil profile much like that of the Clarksburg series. The depth to the claypan in the areas modified by colluvium is greater than in other areas of Guernsey soils.

Included with the Guernsey soils are a few acres of similar soils that have developed from acid shale. They are on some of the benches and ridgetops in the Gilpin

area of the county. In the lower subsoil, these included soils are strongly acid.

Topography: Upper benches and broad ridgetops. Slopes range from about 3 to 30 percent; dominant slopes are about 10 percent.

Drainage: Moderately well drained.

Permeability: Moderate to slow to the claypan and very slow in the claypan.

Use and management: Guernsey soils hold moisture well and have good natural fertility. They are mainly used for hay. The slowly permeable subsoil somewhat limits the growth of deep-rooted legumes. The Guernsey soils are erodible and puddle if worked when too wet.

Guernsey silt loam, 3 to 10 percent slopes (Gx).—This gently sloping soil has moderate erosion. All crops commonly grown in the county can be grown on this soil, but the growth of deep-rooted legumes is restricted somewhat. Simple conservation practices and good management to control erosion and maintain good tilth are needed. An occasional seep spot may need artificial drainage. Capability unit IIe-14.

Guernsey silt loam, 10 to 20 percent slopes (Gy).—Because slopes are steeper, this soil is more limited in use and needs more intensive erosion control than Guernsey silt loam, 3 to 10 percent slopes. Some areas on benches have a hummocky appearance because of slips. Seep spots are not uncommon. A few acres of this mapping unit are severely eroded. Capability unit IIIe-14.

Guernsey silt loam, 20 to 30 percent slopes, severely eroded (Gz).—The profile of this soil is similar to that described as representative for the series, except that most of the topsoil has been lost through erosion. The present plow layer is low in organic matter, has poor tilth, and is slowly permeable. Because of the severe erosion and the risk of further erosion, this soil should be kept under close-growing cover crops most of the time. Capability unit IVe-9.

Holston series

The Holston series consists of deep, well-drained terrace soils. These soils have developed on old alluvial sediments that have washed from upland soils underlain by acid sandstone and shale. They occur on flats above the steep sidehills along Wheeling Creek, Fish Creek, and the Ohio River. Holston soils are associated with Monongahela soils but lack the fragipan characteristic of Monongahela soils.

Representative profile (Holston silt loam in a meadow, on a slope of about 6 percent) :

- A_v 0 to 8 inches, dark-brown (10YR 4/3) silt loam; moderate, medium to fine, granular structure; friable when moist; many fine roots; strongly acid; clear boundary; 5 to 9 inches thick.
- A₂ 8 to 14 inches, dark-brown (10YR 4/3) silt loam; moderate, medium, granular structure, tending to weak, fine, platy; friable; many roots; strongly acid; gradual boundary; 4 to 7 inches thick.
- B₂ 14 to 23 inches, strong-brown (7.5YR 5/6) silty clay loam; moderate, medium, subangular blocky structure; firm when moist, nonsticky when wet; some roots; many peds clay coated; strongly acid; gradual boundary; 5 to 12 inches thick.
- B₂₂ 23 to 34 inches, dark-brown (7.5YR 5/4) silty clay loam; moderate, medium, subangular blocky structure; firm when moist; clay coats on many peds; strongly acid; gradual boundary; 7 to 15 inches thick.

- B₃ 34 inches +, dark-brown (7.5YR 4/4) clay loam; massive, tending toward coarse, platy structure; firm when moist, slightly sticky when wet; clay coats on some peds; high in mica; high accumulation of manganese; strongly acid; gradual boundary.

Range in characteristics: The subsoil ranges from dark brown to yellowish brown or yellowish red in color and from silty clay loam to clay loam in texture. Sandy layers frequently occur below 34 inches.

Topography: Nearly level to strongly sloping. Slopes range from about 2 to 25 percent; dominant slopes are about 8 percent.

Drainage: Well drained.

Permeability: Moderate the first 30 to 36 inches and slow beyond that depth.

Use and management: These soils are suited to the crops commonly grown in the county. Because of the gentle topography and the rather rapid infiltration, only a few acres have been severely eroded. The soils need good management, including simple conservation practices, to control erosion and to maintain good fertility.

Holston silt loam, 2 to 8 percent slopes (Ha).—Slopes are gentle and erosion is slight to moderate. Any of the crops commonly grown in the county do well on this soil. Good management is needed to control erosion and to maintain fertility. This soil is frequently low in potassium. Capability unit IIe-4.

Holston silt loam, 8 to 15 percent slopes (Hb).—This soil can be used for the production of any crops grown in the county. Intensive conservation and other management practices are needed. A few acres of this soil are severely eroded. Capability unit IIIe-4.

Holston silt loam, 15 to 25 percent slopes (Hc).—This soil is more susceptible to erosion than the other Holston soils because of slope. A few acres are severely eroded. This soil should be kept under a permanent cover in order to keep it fertile and to control erosion. Capability unit IVe-3.

Huntington series

The Huntington series consists of deep, well-drained, bottom-land soils. These soils have developed from recent alluvium washed from uplands underlain by alkaline sandstone and shale. They occur in association with moderately well drained Lindside and poorly drained Melvin soils of the bottom lands. Huntington soils occur almost entirely along the Ohio River, Wheeling Creek, and Fish Creek.

Representative profile (Huntington silt loam on 0 to 3 percent slopes in a cornfield near Cresap) :

- A_v 0 to 13 inches, dark-brown (10YR 3/3) silt loam; moderate, medium, granular structure; loose; many fine roots; slightly acid; clear boundary; 7 to 14 inches thick.
- C₁ 13 to 24 inches, dark grayish-brown (10YR 4/2), heavy silt loam; tending to weak, medium prisms; friable; many fine roots; clay coats on some peds; medium acid; gradual boundary; 9 to 16 inches thick.
- C₂ 24 to 45 inches +, dark yellowish-brown (10YR 4/4) silty clay loam; weak, fine, subangular blocky structure; slightly firm; some roots; clay coats on some peds; medium acid; 30 to 50 inches thick.

Range in characteristics: The texture of the surface soil ranges from fine sandy loam to silty clay loam, but it is dominantly silt loam. The texture of the subsoil ranges from silt loam to sandy clay loam or silty clay

loam. Flooding varies from once in 10 to 15 years to two or three times per year.

Topography: Level to nearly level bottom land

Drainage: Well drained.

Permeability: Moderate for most of the series. Somewhat rapid in the fine sandy loam and slow in the silty clay loam.

Use and management: The soils of this series are very fertile. They are suited to all crops grown in the county, but occasional flooding during the winter or early spring months may limit their use suitability. Most of the Huntington soils along the Ohio River are no longer used for agriculture because of industrial development on the adjacent Wheeling soils.

Huntington silt loam, 0 to 3 percent slopes (He).—This soil has good tilth and high natural fertility, but use is limited by floods. This hazard must be judged locally. Simple conservation practices and good management to maintain fertility are needed. Capability unit I-6.

Huntington fine sandy loam, 0 to 3 percent slopes (Hd).—This soil has a profile similar to that described as representative of the series. However, it has a coarser textured surface soil and subsoil, is lower in organic matter content, and is more permeable. Most of this soil floods frequently. Generally, it can best be used for pasture. Capability unit I-6.

Huntington silty clay loam, 0 to 3 percent slopes (Hf).—This soil has a profile similar to that described as representative for the series, but it has a finer textured surface soil and subsoil and slower permeability. This soil is not so well suited to truck crops as the silt loam and fine sandy loam types because good tilth is harder to maintain. A large amount of organic matter is needed. Capability unit I-6.

Lakin series

The soils of the Lakin series have developed on wind-blown, sandy deposits from the Ohio River. They are deep, excessively drained soils. They occur as irregular or hummocky deposits on water-laid terraces. The most extensive area of Lakin soils is near the mouth of Fish Creek.

Only one soil in the Lakin series has been mapped in the county.

Representative profile (Lakin loamy sand on 10 to 20 percent slopes) :

- A_p 0 to 9 inches, dark-brown (10YR 4/3) loamy sand; weak, fine, granular structure; loose; many fine roots; strongly acid; clear boundary; 5 to 9 inches thick.
- A₂ 9 to 15 inches, dark yellowish-brown (10YR 4/4) loamy fine sand; weak, fine, granular structure; loose; many fine roots; strongly acid; clear boundary; 4 to 8 inches thick.
- B-C 15 to 60 inches +, pale-brown (10YR 6/3) loamy fine sand with lenses of dark brown (7.5YR 4/4); structureless; lenses show some clay and are somewhat firm when moist, slightly hard when dry; some fine roots; strongly acid; several feet thick.

Range in characteristics: Lenses of sandy clay, generally referred to as a discontinuous B horizon, may improve the available moisture-holding capacity of these soils. They usually range from ½ to five inches in thickness, although some are thicker. They normally occur horizontally, have some dip and waves, and often end abruptly. The lenses occur in no particular pattern.

In some places they are 2 inches apart and in others are a foot or more. Generally, they increase with depth.

Topography: Irregular and hummocky. Slopes range from 10 to 20 percent.

Drainage: Excessive.

Permeability: Rapid.

Use and management: Lakin soils are not important agriculturally in the county because of their small extent. They are low in fertility and are droughty.

Lakin loamy sand, 10 to 20 percent slopes (Lc).—Early vegetables and small fruits are the most suitable crops for this soil. Heavy applications of manure and fertilizer and the use of cover crops are needed to make the soil productive. Capability unit IVE-5.

Lindsay series

The Lindsay series consists of deep, moderately well drained to somewhat poorly drained, bottom-land soils. These soils have developed from recent alluvium washed from upland soils predominantly influenced by limestone. They occur along the Ohio River, Fish Creek, and Wheeling Creek and are subject to flooding. They are associated with well-drained Huntington and poorly drained Melvin soils of the bottom lands that have been influenced by limestone.

Only one soil in the Lindsay series has been mapped in the county.

Representative profile (Lindsay silt loam on 0 to 3 percent slopes in a cornfield near Cresap) :

- A_p 0 to 10 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, medium, granular structure; friable; slightly acid; clear boundary; 7 to 12 inches thick.
- C 10 to 24 inches, dark yellowish-brown (10YR 4/4) silt loam; faint mottles of strong brown (7.5YR 5/8) beginning at 15 inches; structureless; friable; slightly acid; gradual boundary; 10 to 17 inches thick.
- C_a 24 to 36 inches +, grayish-brown (10YR 5/2) silty clay loam; gray (10YR 5/1) and strong-brown (7.5YR 5/8), distinct mottles; structureless; friable, becoming at 3 feet rather firm when moist and slightly sticky when wet; many iron and manganese concretions; slightly acid.

Range in characteristics: Flooding varies from two or three times a year to once in every 4 or 5 years.

Topography: Nearly level flood plain.

Drainage: Moderately well drained to somewhat poorly drained.

Permeability: Moderate to slow.

Use and management: Natural fertility is high on the Lindsay soils, and moisture-holding capacity and organic-matter content are above average. A high water table is common.

Lindsay silt loam, 0 to 3 percent slopes (Lb).—This soil is suitable for the production of most crops, but, because of risk of flooding and restricted internal drainage, the use is somewhat limited. Deep-rooted legumes are the crops most difficult to grow. Capability unit IIw-7.

Made land

Made land (Ma) consists of areas that have been excavated, filled, or graded, and, as a result, the original soil features have been destroyed. Towns and industrial sites comprise 99 percent of the total acreage of Made land mapped in this county.

Melvin series

The Melvin series consists of deep, poorly drained soils of the bottom lands. These soils have developed from recent sediments washed from upland areas influenced by lime. Most areas of Melvin soils are subject to flooding. They occur along the Ohio River, Fish Creek, and Wheeling Creek. They are generally in low, sloughlike and bottom-land areas of 3 or 4 acres at the base of upland, colluvial, or terrace soils. These soils have weakly expressed profiles.

Only one soil in the Melvin series has been mapped in the county.

Representative profile (Melvin silt loam on 0 to 3 percent slopes):

- A₁ 0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; distinct, fine mottles of strong brown (7.5YR 5/8); friable; slightly acid; gradual boundary; 5 to 10 inches thick.
- C 8 to 36 inches, grayish-brown (10YR 5/2) light silty clay loam; many medium, distinct, gray (10YR 5/1) and strong-brown (7.5YR 5/8) mottles; friable when moist, slightly plastic when wet; many roots from swamp vegetation; slightly acid; 20 to 40 inches thick.

Range in characteristics: The texture of the subsoil ranges from silt loam to silty clay loam or sandy clay loam. The underlying material varies but in most places is sand and gravel.

Topography: Nearly level bottom land.

Drainage: Poorly drained.

Permeability: Slow.

Use and management: Melvin soils are limited in use because water stands on them during much of the year. They flood frequently, particularly in sloughlike areas. They are high in organic-matter content, and they have good natural fertility.

Melvin silt loam, 0 to 3 percent slopes (Mb).—Some artificial drainage is needed on this soil before it can be effectively used for improved pasture or for hay or rotation crops. Long rotations should be used. Alfalfa grows very poorly on these soils. Capability unit IIIw-1.

Mine dumps

Mine dumps (Mc) are uneven accumulations or piles of waste materials, coal, and slate resulting from mining and other industrial operations. They have little or no agricultural value, and most areas are incapable of supporting vegetation.

Monongahela series

The Monongahela soils are deep and moderately well drained. They have a fragipan layer or a decidedly compact zone in the lower subsoil. They occur on stream terraces along the Ohio River, Fish Creek, and Wheeling Creek and are well above overflow. Most of the terraces are above the almost perpendicular valley walls.

Representative profile (Monongahela silt loam in an idle field on 2 to 8 percent slopes):

- A_p 0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; loose; strongly acid; clear boundary; 4 to 10 inches thick.
- A₂ 8 to 13 inches, yellowish-brown (10YR 5/4) silt loam; weak, fine, platy structure; friable; many roots; strongly acid; gradual boundary; 3 to 6 inches thick.
- B₂ 13 to 21 inches, yellowish-brown (10YR 5/6) silt loam; weak, fine, subangular blocky structure; firm; many

roots; faint clay coats on pedis; strongly acid; gradual boundary; 7 to 11 inches thick.

- B₃ 21 to 30 inches, yellowish-brown (10YR 5/6) sandy clay loam; 5 percent mottled with strong brown (7.5YR 5/8) and light brownish gray (2.5YR 6/2); weak, coarse, subangular blocky structure; very firm; some manganese coatings and concretions; few roots and pores; strongly acid; 6 to 12 inches thick.

- C 30 to 56 inches, yellowish-brown (10YR 5/6) sandy loam; 20 percent consists of mottles of strong brown and light grayish brown; massive structure; extremely firm; pores prominent; some clay pockets; many manganese coatings; strongly acid; 20 to 40 inches thick.

Range in characteristics: Depth to the fragipan layer ranges from 18 to 26 inches. The subsoil ranges from silty clay loam to sandy clay loam. Rounded river rocks occur in some places. The material beneath the fragipan zone varies. It is shale, sandstone, or clay. There are a few acres of Monongahela soils grayer and more poorly drained than typical of the series.

Topography: Nearly level to moderately sloping terrace benches.

Drainage: Generally moderately well drained; small included areas are somewhat poorly drained.

Permeability: Slowly permeable in the fragipan.

Use and management: These soils are low in natural fertility and very low in potassium. Artificial drainage is needed on the somewhat poorly drained areas. The growth of deep-rooted legumes is somewhat limited by the fragipan. Water accumulates on this pan during the winter, and the soils are rather slow to dry and to become firm in spring.

Monongahela silt loam, 2 to 8 percent slopes (Md).—Most of this soil is moderately well drained. A small part is somewhat poorly drained and needs some artificial drainage. An occasional seep spot in the moderately well drained areas also requires artificial drainage. If the fertility is built up and maintained, good yields can be expected on this soil. All crops commonly grown in the county can be produced, but deep-rooted legumes have limited growth. Capability unit IIe-13.

Monongahela silt loam, 8 to 15 percent slopes (Me).—This soil is moderately well drained except for an occasional seep spot that needs artificial drainage. It can be used for about the same crops as the less sloping Monongahela silt loam. However, because of steeper slopes, it requires more intensive soil management and erosion control measures. Capability unit IIIe-13.

Robertsville series

The Robertsville series consists of deep, somewhat poorly to poorly drained, terrace soils. These soils have developed on alluvial sediments washed from upland soils influenced by lime. They occupy the wet flats or depressed areas along Wheeling Creek in association with Captina silt loam.

Only one soil of the Robertsville series has been mapped in the county.

Representative profile (Robertsville silt loam on 0 to 5 percent slopes in a legume-grass meadow along Wheeling Creek):

- A_p 0 to 8 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, coarse, granular structure; friable; many wormholes; slightly acid; abrupt boundary; 5 to 10 inches thick.

B_{2g} 8 to 15 inches, olive-gray (5Y 5/2) light silty clay loam; many, prominent, fine mottles of brown (7.5YR 5/6), some dark reddish-brown mottles (5YR 3/4); weak, coarse prisms; friable when moist, slightly sticky when wet; clay in pores and wormholes; some fine, reddish-brown (5YR 5/4) concretions; medium acid; 5 to 10 inches thick.

B_{3g} 15 to 30 inches +, olive-gray (5Y 5/2) silty clay; prominent, fine mottles of strong brown (7.5YR 5/8); massive structure; slightly plastic; wormholes are clay coated; some mica flakes; many manganese concretions; medium acid; 12 to 25 inches thick.

Range in characteristics: These soils range from strongly acid to slightly acid. The texture of the subsoil ranges from silty clay loam to silty clay. The lower subsoil of the area along the Ohio River is stratified gravelly material in places.

Topography: Nearly level terrace flats above flood plains.

Drainage: Somewhat poorly to poorly drained. Runoff is slow to very slow.

Permeability: Slow to very slow.

Use and management: These soils puddle easily and warm slowly in spring. Some artificial drainage is needed before they can be used successfully for improved pasture, hay, or a crop rotation. Deep-rooted legumes do very poorly on these soils.

Robertsville silt loam, 0 to 5 percent slopes (Ra).—

Long rotations should be used on this soil to maintain the best tilth possible. The addition of organic matter will help maintain good tilth. Capability unit IVw-3.

Upshur series

The Upshur soils are reddish, well-drained soils on purplish, red, or reddish-brown shales. They occupy areas near the ridgetops on saddles, knobs, and benches. Upshur soils are not mapped separately in Marshall County; they are mixed with Gilpin soils in complexes. The mapping units are listed under the Gilpin-Upshur complex.

Representative profile (Upshur silty clay loam on a slope of about 15 percent in a meadow along Ridge Road, 3 miles east of Franklin):

A_p 0 to 6 inches, dark reddish-brown (5YR 3/3) silty clay loam; moderate, fine, granular to moderate, medium, subangular blocky structure; friable; strongly acid; clear boundary; 5 to 8 inches thick.

B₂ 6 to 14 inches, reddish-brown (5YR 4/3) clay; moderate, medium and coarse, blocky structure; firm when moist, sticky and plastic when wet; many wormholes and fine pores; clay films on ped faces and in pores; slightly acid; clear boundary; 5 to 10 inches thick.

B₃ 14 to 25 inches, dark reddish-brown (2.5YR 3/3) clay; contains weathered siltstone and shale that are olive yellow (2.5Y 6/6) and yellowish brown (10YR 5/6); massive, breaking to fine and medium, blocky structure; firm when moist, sticky and plastic when wet; clay films on ped faces and in pores; some fine pores; 10 percent consists of coarse fragments; slightly acid; 9 to 14 inches thick.

C 25 inches +, horizon is made up of horizontal layers of weak, red shale, gray sandstone, and gray shale; shale fragments comprise 60 to 80 percent of mass; clay coats on rock fragments and in cracks; manganese coats cover some shale fragments; concretions up to 1 inch in size are numerous; a small part of the mass is olive-brown (2.5Y 4/4) weathered siltstone that is conspicuous because of the strongly contrasting colors; slightly acid.

Westmoreland series

In the Westmoreland series are moderately deep, well-drained, lime-influenced soils of the uplands. They have

developed from interbedded alkaline and acid shale, siltstone, micaceous sandstone, and thin lenses of limestone. They are by far the dominant soils in the northern two-thirds of the county. Small areas of Brooke, Guernsey, and Gilpin-Upshur soils are associated with the Westmoreland soils.

Representative profile (Westmoreland silt loam on a slope of about 18 percent in a wooded area near intersection of county highways 8 and 2/4):

A_p 0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, fine, granular structure; loose; many fine and coarse roots; strongly acid; clear boundary; 6 to 10 inches thick.

B₁ 8 to 13 inches, yellowish-brown (10YR 5/4) silt loam; weak, medium, subangular blocky structure; friable when moist, nonsticky and very slightly plastic when wet; many fine and coarse roots; clay coats on some peds; medium acid; clear boundary; 3 to 7 inches thick.

B₂ 13 to 26 inches, yellowish-brown (10YR 5/4) silty clay loam; moderate, medium, subangular blocky structure; friable when moist but slightly sticky when wet; many fine roots and pores; thin clay coats on peds; medium acid; 10 to 16 inches thick.

C₁ 26 to 35 inches, 85 percent consists of weathered shale and siltstone, about one-half of which breaks into fragments less than 1 inch in diameter; shale fragments are olive brown (2.5Y 4/4) inside; light olive-brown (2.5Y 5/4) silty clay loam occurs between the particles of weathered shale and siltstone; a few fine roots are between shale fragments; medium acid; irregular boundary.

D_r 35 inches +, thin-bedded sandstone and siltstone containing thin layers of calcareous shale and limestone.

Range in characteristics: The thickness of the different horizons varies, but the profile is usually less than 40 inches deep. The shallowest areas are at the upper edge of steep slopes, on narrow ridgetops, and at the points of ridges. The subsoil is dominantly a silty clay loam, but the texture ranges from light silty clay loam to silty clay. The texture of the subsoil depends on the nature of the parent material. If the parent material contains much sandstone, the subsoil is a light silty clay loam and is generally strongly acid. If siltstone and alkaline shale are dominant in the parent material, the subsoil is heavier and is only slightly acid.

Topography: Gently rolling tops and upper slopes on a long series of detached hills and knobs. Slopes are stronger near the stream-cut gorges and are very steep in the gorges. They range from 3 to 55 percent but are dominantly 20 to 35 percent.

Drainage: Well drained.

Permeability: Moderate.

Use and management: The Westmoreland are the "bread and butter" agricultural soils of the county. They account for 55 to 60 percent of the total acreage of cropland and 65 to 70 percent of the total acreage of pasture.

The soils have high natural fertility and hold moisture well, but they are very erodible if cultivated (fig. 10). All areas of Westmoreland soils suitable for cultivation will produce all the crops commonly grown in the county, and they are particularly desirable for alfalfa. High yields can be expected if fertility is maintained and erosion is controlled. Slips are common on these soils, mainly on gentle slopes in pastures.

Westmoreland silt loam, 3 to 10 percent slopes (Wa).— Areas of this soil generally occupy a few acres on the

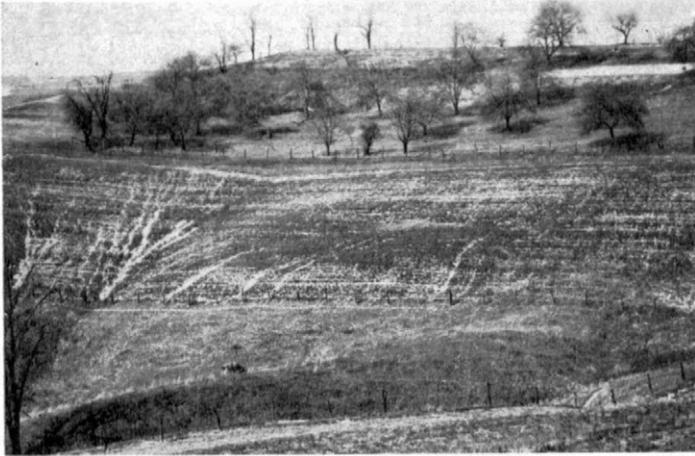


Figure 10.—Erosion in alfalfa field caused by unusually heavy rains.

broader ridgetops and are managed with the surrounding soils. Slopes are favorable for rather intensive cultivation if erosion is controlled. This soil is suited to all crops grown in the county. Capability unit IIe-11.

Westmoreland silt loam, 10 to 20 percent slopes (Wb).—A large part of the acreage on ridgetops in the northern two-thirds of the county is in this soil. It is a productive soil. If erosion is carefully controlled and other good management is practiced, it can be used for all the crops commonly grown. Capability unit IIIe-11.

Westmoreland silt loam, 10 to 20 percent slopes, severely eroded (Wc).—This soil has lost most of its original silt loam surface soil through erosion. Consequently, its plow layer is lower in organic matter, heavier textured, poorer in tilth, and less permeable to moisture than the corresponding layer in less eroded Westmoreland silt loams. More intensive erosion control and soil management are needed than on the less eroded soils on corresponding slopes. Most crops suitable for the soils in the county can be grown on this soil. Capability unit IVe-1.

Westmoreland silt loam, 20 to 30 percent slopes (Wd).—This soil should be kept in permanent vegetation most of the time because of the risk of erosion on these strong slopes. Yields above average can be obtained if erosion is controlled. Capability unit IVe-1.

Westmoreland silt loam, 20 to 30 percent slopes, severely eroded (We).—The present surface layer is a mixture of remnants of the original surface soil with silty clay loam from the subsoil. The supply of organic matter is low, and tilth is poor. As a result, moisture is absorbed very slowly and much soil material is carried away by runoff. To prevent further damage, the soil should be used only for permanent hay or pasture. Some of the severely eroded areas should be retired to woods. Capability unit IVe-1.

Westmoreland silt loam, 30 to 40 percent slopes (Wf).—This soil is on hillsides where some soil material moves down the slope. The profile on the upper two-thirds of the slope is more shallow than that described for the series, but that on the lower one-third is normally deeper. Pasture is a good use if erosion is controlled and the soil is otherwise well managed. Most of this soil is in pasture. Capability unit VIe-3.

Westmoreland silt loam, 30 to 40 percent slopes, severely eroded (Wg).—Except for having lost most of the original surface soil, the profile of this soil is similar to that described for the series. The present surface layer is low in organic matter. Runoff is excessive. The soil should be used for pasture or woods. Pasture will need to be carefully managed to control erosion. A few acres are very severely eroded and have slips and gullies that make them unsuitable for pasture. Capability unit VIe-3.

Westmoreland silt loam, 40 to 55 percent slopes (Wh).—This soil is shallower to bedrock than the less sloping Westmoreland silt loams. More fragments weathered from the interbedded shale and sandstone have been mixed with the soil. Most of this soil is on the steep valley walls of the Ohio River, Wheeling Creek, and Fish Creek. Because of the strong slope, this soil should be used only for woods. Capability unit VIIe-1.

Westmoreland silt loam, 40 to 55 percent slopes, severely eroded (Wk).—This soil is like Westmoreland silt loam, 40 to 55 percent slopes, but it has lost most of its surface soil through erosion. This steep soil is suitable only for woods. Capability unit VIIe-1.

Wheeling series

In the Wheeling series are deep, well-drained terrace soils that have developed from water-laid sands and gravel. They occupy the nearly level to gently sloping benches above the normal flood area. Wheeling soils are no longer important agriculturally in the county. They are occupied mostly by industrial sites and towns.

Representative profile (Wheeling silt loam on 3 to 10 percent slopes):

- A_p 0 to 14 inches, dark-brown (10YR 3/3) silt loam; moderate, fine, granular structure; friable; strongly acid; clear boundary; 8 to 14 inches thick.
- B₂ 14 to 30 inches, yellowish-brown (10YR 5/4) silty clay loam; moderate, medium, subangular blocky structure; firm; clay coats on peds; strongly acid; diffused boundary; 15 to 20 inches thick.
- B₃ 30 to 56 inches, dark yellowish-brown (10YR 4/4) sandy clay loam; weak, medium, subangular blocky structure; firm; clay accumulation in the numerous fine pores; some manganese concretions; strongly acid; gradual boundary; 20 to 30 inches thick.
- B_{3a} 56 to 72 inches, dark yellowish-brown (10YR 4/4) sandy loam, streaked with dark brown; weak, coarse, subangular blocky structure; friable; some clay accumulation in pockets; strongly acid; gradual boundary; 10 to 20 inches thick.
- D 72 inches +, dark grayish-brown, stratified, loose sand and gravel.

Range in characteristics: Texture of the surface soil ranges from sandy loam to silt loam, both gravelly and nongravelly. Subsoil textures range from sandy clay loam to silty clay loam. Depth to coarse gravel ranges from none to 6 feet.

Topography: Nearly level terraces except on narrow breaks along the edge of the adjacent flood plains.

Drainage: Well drained.

Permeability: Moderate to moderately rapid.

Use and management: If these soils are properly fertilized, high yields can be expected from any of the crops generally grown in the county. However, the sandy loam types of Wheeling soils do not have a very large amount of organic matter, and their yields are sometimes below average in drier years. Gravel occurs on the surface in

local areas of Wheeling soils but does not seriously interfere with cultivation.

Wheeling silt loam, 0 to 3 percent slopes (Wo).—Erosion is slight on this soil. It can be used for the production of any crops that are grown in the county. Simple conservation practices and management that maintain tilth and fertility are needed to keep this soil permanently productive. Capability unit I-4.

Wheeling silt loam, 3 to 10 percent slopes (Wp).—This soil can be used intensively for any crops suitable for production in the county if erosion is controlled and fertility maintained. Because of slope, this soil needs more intensive conservation practices than Wheeling silt loam, 0 to 3 percent slopes. Capability unit IIe-4.

Wheeling sandy loam, 0 to 3 percent slopes (Wm).—The sandy and gravelly Wheeling soils in the county are mapped as Wheeling sandy loam. The gravelly areas occur more or less as local gravel bars. A brief profile description of Wheeling sandy loam follows to illustrate some of the differences that are mentioned for the Wheeling series under Range in characteristics.

- A₁ 0 to 9 inches, very dark brown (10YR 2/2) fine sandy loam.
- A₂ 9 to 15 inches, dark yellowish-brown (10YR 4/4) fine sandy loam; loose.
- B₂₁ 15 to 25 inches, dark-brown (7.5YR 4/4) sandy loam or sandy clay loam; weak, coarse, subangular blocky structure; slightly firm.
- B₂₂ 25 to 36 inches, dark-brown (7.5YR 4/4) fine sandy loam; very weak, medium, subangular blocky structure; friable.
- C 36 inches +, yellowish-brown (10YR 5/4) loamy fine sand; gravel at 40 inches.

The uses for Wheeling sandy loam, 0 to 3 percent slopes, are the same as for Wheeling silt loam, 0 to 3 percent slopes. Lack of organic matter and moisture sometimes reduces yields on this sandy loam. Capability unit I-4.

Wheeling sandy loam, 3 to 10 percent slopes (Wn).—The profile of this soil is the same as that described for Wheeling sandy loam, 0 to 3 percent slopes. Simple conservation practices and good management are needed to control erosion and produce good yields. The available moisture-holding capacity should be improved by increasing the organic-matter content. Capability unit IIe-4.

Wyatt series

The Wyatt series consists of deep, somewhat poorly drained, claypan soils influenced by limestone. These terrace soils have developed from water-laid material that has washed from upland soils underlain by interbedded sandstone, shale, and limestone. They differ from the other terrace soils in the county in that they have developed under slack-water conditions and are, therefore, finer textured. They are also less acid, particularly at a depth of 3 feet or more. The Wyatt soils occur on the benches of Fish Creek near Graysville.

Representative profile (Wyatt silt loam on 3 to 8 percent slopes in a pasture at Graysville):

- A_p 0 to 8 inches, olive-brown (2.5Y 4/4) silt loam; weak, medium, granular structure; friable; strongly acid; clear boundary; 6 to 10 inches thick.
- B₁ 8 to 16 inches, yellowish-brown (10YR 5/4), light silty clay loam; many distinct fine mottles of grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/8) at 15 inches; moderate, medium, subangular blocky structure; aggregates arranged in coarse prisms; firm when

moist, nonsticky when wet; many fine pores; faint clay coats on most peds; medium acid; gradual boundary; 6 to 10 inches thick.

- B_{2g} 16 to 25 inches, yellowish-brown (10YR 5/4) clay; many, coarse, distinct mottles of grayish brown (2.5Y 5/2) and strong brown (7.5YR 5/6); weak, medium, subangular blocky structure, tending to massive; clay coats prominent on surface of all peds, and clay occurs in old root channels; some fine pores; medium acid; gradual boundary; 7 to 10 inches thick.
- C 25 inches +, brown (10YR 5/3) and light brownish-gray (2.5Y 6/2) clay; moderate, coarse, prismatic structure; very firm; numerous manganese coatings; few decayed roots; very slightly acid.

Range in characteristics: Depth to mottling ranges from 15 to 24 inches. Depth to neutral material ranges from 25 to 36 inches.

Topography: Nearly level river terraces along the breaks between terrace levels and local dissected areas; some steep slopes.

Drainage: Somewhat poorly drained to moderately well drained. Runoff is slow on gentle slopes.

Permeability: Slow to claypan zone; very slow in claypan.

Use and management: The very slow permeability and somewhat poor internal drainage are serious problems in the use and management of Wyatt soils. These soils warm late and puddle easily. They are not suited to deep-rooted legumes.

Wyatt silt loam, 3 to 8 percent slopes (Wr).—Slopes are gentle, and erosion is slight or moderate. Most row crops can be grown on this soil, but long rotations should be used. Capability unit IIIw-5.

Wyatt silt loam, 15 to 30 percent slopes (Ws).—This soil has better internal drainage than that representative of the series. It occurs chiefly as narrow bands in the steep breaks around the Wyatt silt loam on 3 to 8 percent slopes. Because of slope and erosion, the best use of this soil is for permanent pasture or woods. Capability unit VIe-1.

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