United States
Department of
Agriculture

Soil
Conservation
Service

In cooperation with
Missouri Agricultural
Experiment Station

Soil Survey of Randolph County, Missouri

How To Use This Soil Survey

General Soil Map

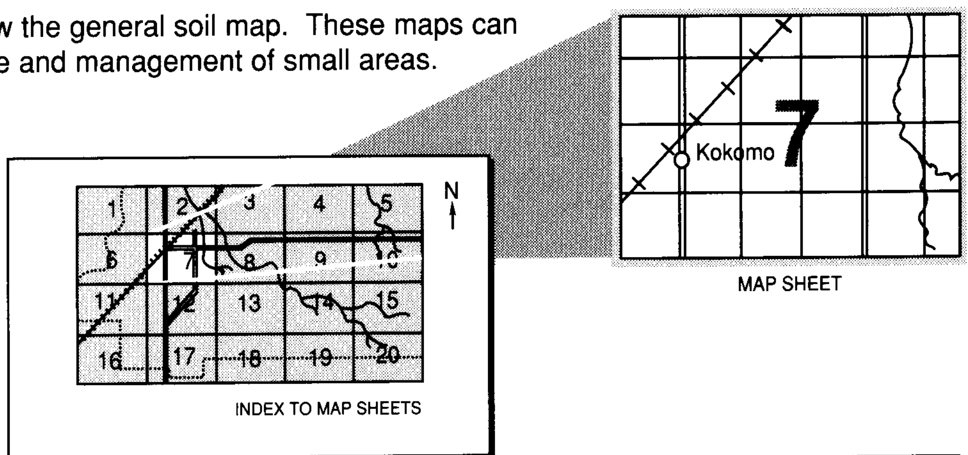
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

Detailed Soil Maps

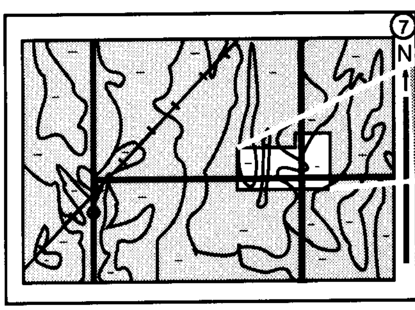
The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.

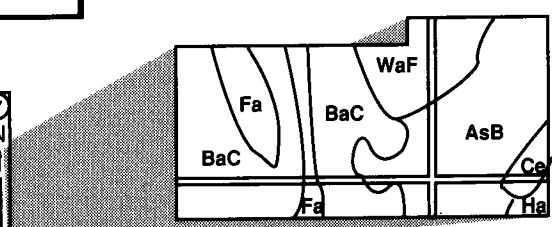


MAP SHEET

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



MAP SHEET



AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1985. Soil names and descriptions were approved in 1986. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1985. This survey was made cooperatively by the Soil Conservation Service and the Missouri Agricultural Experiment Station. The Missouri Department of Natural Resources provided a soil scientist to assist with the fieldwork. The county commission, private businesses, and individuals donated funds through the Randolph County Soil and Water Conservation District. These funds were used to provide a soil scientist to assist with the fieldwork. The survey is part of the technical assistance furnished to the Randolph County Soil and Water Conservation District.

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

All programs and services of the Soil Conservation Service are offered on a nondiscriminary basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: An area of Lagonda silt loam, 5 to 9 percent slopes, eroded.

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Soil Series

Issued June 1989

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Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Randolph County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Russell C. Mills
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Soil Survey of Randolph County, Missouri

By Dennis K. Potter, Soil Conservation Service

Fieldwork by Dennis K. Potter and Carol A. Bartles, Soil Conservation Service; Sammy J. Grimes, Missouri Department of Natural Resources; and Lisa A. Gaughan and Rex S. Jackson, Randolph County Soil and Water Conservation District

United States Department of Agriculture, Soil Conservation Service, in cooperation with the Missouri Agricultural Experiment Station

RANDOLPH COUNTY is in the north-central part of Missouri (fig. 1). It has an area of 312,230 acres, or about 488 square miles. Huntsville, the county seat, is in the west-central part of the county.

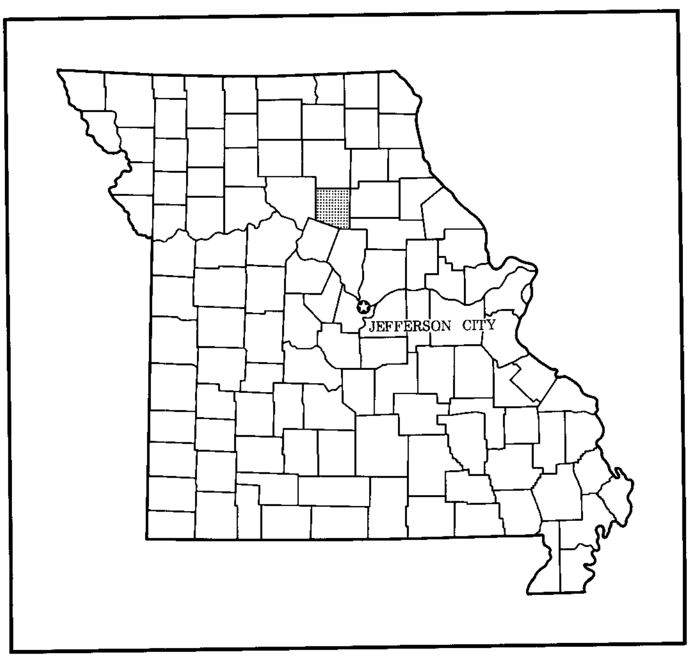

Figure 1.—Location of Randolph County in Missouri.

General Nature of the County

This section gives general information about the county. It describes climate, natural resources, history and development, farming, and physiography, relief, and drainage.

Climate

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

The consistent pattern of climate in Randolph County is one of cold winters and long, hot summers. Heavy rains occur mainly in spring and early in summer, when moist air from the Gulf of Mexico interacts with drier continental air. The annual rainfall is normally adequate for corn, soybeans, and small grain.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Moberly, Missouri, in the period 1951 to 1981. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on the length of the growing season.

In winter the average temperature is 30 degrees F, and the average daily minimum temperature is 21 degrees. The lowest temperature on record, which occurred at Moberly on January 11, 1977, is -20 degrees. In summer the average temperature is 75 degrees, and the average daily maximum temperature is 87 degrees. The highest recorded temperature, which occurred on July 14, 1954, is 112 degrees.

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

The total annual precipitation is 37.37 inches. Of this, about 24 inches, or 65 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 19 inches. The heaviest 1-day rainfall during the period of record was 8.28 inches at Moberly on April 21, 1973. Thunderstorms occur on about 51 days each year. Tornadoes and severe thunderstorms strike occasionally but are local in extent and of short duration. They can cause damage in scattered spots. Hailstorms sometimes occur in scattered small areas during the warmer part of the year.

The average seasonal snowfall is nearly 19 inches. The greatest snow depth at any one time during the period of record was 11 inches. On the average, 14 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the south-southwest. Average windspeed is highest, 12 miles per hour, in spring.

Natural Resources

A vast resource of coal has influenced the development of Randolph County. Numerous quarry and mining companies currently operate in the county, employing a large part of the work force. The county has some of the largest coal deposits in Missouri. These deposits were first extracted by shaft mining methods. Shafts with depths of 200 feet or more were not uncommon *(3)*. By 1935, the more easily reached coalbeds had been depleted and the first surface mining began.

Some present-day surface mining activities require the removal of 100 or more feet of overburden. Surface horizons of premined soils generally are removed and then replaced following the surface mining activities. This process was begun in about 1972. Prior to that year, the overburden spoil material was placed at random, with no attempt to ensure an acceptable medium for plant growth. A large percentage of the coal currently extracted is used by a large power plant near Thomas Hill.

Limestone extracted for use as gravel and agricultural lime is a significant resource in the county.

History and Development

The Missouri, Iowa, and Illinois Indians once inhabited the area now known as Randolph County. These tribes left the area because of disease and pressure from the Sac and Fox tribes, who had moved to the area from Quebec. After the War of 1812, the Sac and Fox tribes abandoned their lands in the northern part of Missouri.

The survey area was included in the Louisiana Purchase in 1803. This land acquisition opened the region to further settlement. Most of the early settlers came from Kentucky, Virginia, North Carolina, Tennessee, and what is now Howard County, Missouri. The first homesteader was William Holman, who settled in Silver Creek Township in 1818.

The pioneers built their cabins on wooded slopes, which provided easy access to lumber, water, and shelter. The nearby prairies were used as open range for livestock. The prairies were not settled initially because of the difficulty of working the sod.

Randolph County was organized in 1829. It was named after John Randolph, the Virginia statesman *(4)*. It had been part of Howard County prior to this reorganization.

The first improved road in the county was built from Brunswick to Huntsville in 1835. The advent of the railroad greatly affected the development of the county. The first line to pass through the county was built in 1850. It ran north and south along the Grand Divide from St. Louis to Iowa. Another railroad was built in 1858. It ran east and west from Brunswick to a point east of Huntsville.

The Civil War caused a division among the people of the county. By the end of the war, 600 men had volunteered for the Confederacy and 900 men had joined the Union forces. Following the Civil War, the area of the state that includes Randolph County was nicknamed "Little Dixie."

The population of Randolph County was about 2,500 in 1829. In the 1890's, immigration of miners to newly discovered coal fields caused a sharp increase in population. The population peaked at about 27,600 in 1920 *(15)*. It was about 21,000 in 1970 and 25,460 in 1980.

Farming

Farming is the main enterprise in Randolph County. About 42 percent of the acreage in the county is cropland, and 32 percent is pasture. The main crops are corn, soybeans, wheat, and grasses and legumes. The chief kinds of livestock are beef cattle and hogs. In 1978, the number of farms in the county was 876. The average size of the farms was about 264 acres.

In 1818, when the first settlement was established, approximately 75 percent of the county was covered with hardwoods *(9)*. The wooded areas were steadily cleared and converted to agricultural uses, until only about 17 percent of the county remained forested by the turn of the century.

Before the Civil War, hemp and tobacco were the major crops. Small numbers of cattle were raised to supplement the farm income and to supply food to individual families. Following the Civil War, the production of grain, especially corn, became popular.

The acreage and yields of crops have fluctuated significantly during the past 60 years. In 1929, corn was harvested on 56,000 acres, yielding 34 bushels per acre; in 1981, it was harvested on 11,600 acres, yielding about 115 bushels per acre *(5)*.

Soybeans were introduced to the county in the early 1940's as a cover and forage crop. They currently are grown on the largest acreage of any crop in the county. During the period 1950 to 1980, the acreage used for soybeans increased from 16,000 to 61,000 acres and the average yields of this crop increased from 20 to 24 bushels per acre.

The number of livestock in the county has risen and fallen greatly since the turn of the century. The number of cattle and hogs was at a low in 1930, when the county had about 21,000 cattle and 22,000 hogs. In 1970, the county had about 47,600 hogs. In 1975, it had about 45,000 cattle.

Physiography, Relief, and Drainage

Randolph County is nearly equally divided into two major sections. These are the Central Claypan and the Central Mississippi Valley Wooded Slopes Land Resource Areas. These two areas are part of the Central Feed Grains and Livestock Region of the United States *(14)*.

The landscape in Randolph County generally is one of gently sloping to strongly sloping uplands. Most of the county is in the Dissected Till Plains physiographic province. The dissected plains are broken by the Grande Divide, a loess-covered upland ridge extending in a north-south direction. This major divide separates the drainage areas of the Missouri and Mississippi Rivers. The areas east of the divide are drained by Coon Creek, the Elk Fork of the Salt River, and Flat and Mud Creeks. The areas west of the divide are drained by the East and Middle Forks of the Little Chariton River and by Silver and Sweet Spring Creeks.

In the lower reaches of most streams and valleys, the streams have carved deeply into preglacial deposits and have exposed shale and limestone bedrock. In these areas the valleys are narrow and have relatively steep sides. An east-west band of sandstone bedrock about 1.5 miles wide is directly south of Moberly. This band is probably an ancient stream channel that was buried by glacial material and was later exposed by geologic erosion.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

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

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

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

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

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

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

Map Unit Composition

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

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

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

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The descriptions, names, and delineations of the soils identified on the general soil map in this survey do not fully agree with those of the soils identified on the maps of adjacent counties published at a different date. Differences are the result of additional soil data, variations in the intensity of mapping, and correlation decisions that reflect local conditions. In some areas combining small acreages of similar soils that respond to use and management in much the same way is more practical than mapping these soils separately.

Soil Descriptions

1. Mexico-Leonard-Putnam Association

Deep, nearly level to gently sloping, somewhat poorly drained and poorly drained soils formed in loess or in loess and pedisediment; on uplands

This association consists of soils on broad upland divides that have long side slopes and small, branching drainageways. These divides generally are uniform in elevation. They are in the upper reaches of watershed basins. Slopes range from 0 to 6 percent.

This association makes up about 26 percent of the county. It is about 54 percent Mexico and similar soils, 33 percent Leonard soils, 10 percent Putnam soils, and 3 percent minor soils (fig. 2).

Mexico soils are somewhat poorly drained, are very gently sloping and gently sloping, and are on broad ridgetops and side slopes. Typically, the surface layer is very dark grayish brown silt loam. The next layer is dark grayish brown and grayish brown, mottled silty clay loam and very dark grayish brown silt loam. The subsoil is dark grayish brown, mottled silty clay in the upper part; grayish brown, mottled silty clay in the next part; and gray, mottled silty clay loam in the lower part. The substratum is gray, mottled silty clay loam.

Leonard soils are poorly drained and gently sloping and are on the lower, concave side slopes and at the head of drainageways. Typically, the surface layer is very dark grayish brown silt loam. The subsoil is dark grayish brown, mottled silty clay loam in the upper part and gray, mottled silty clay in the lower part.

Putnam soils are poorly drained and nearly level and are on the broad divides. Typically, the surface layer is very dark grayish brown silt loam. The subsurface layer is grayish brown, mottled silt loam. The subsoil is dark gray and grayish brown, mottled silty clay in the upper part and grayish brown, mottled silty clay loam in the lower part. The substratum is gray, mottled silty clay loam.

Minor in this association are the moderately well drained Keswick soils in convex areas on the lowest side slopes.

This association is used mainly for cultivated crops. Some small areas are used for pasture and hay. The major soils are suited to corn, soybeans, grain sorghum, and wheat and to water-tolerant grasses and legumes. The hazard of erosion and surface wetness during spring and winter are the main management concerns in cultivated areas. Overgrazing and grazing when the soils are wet are the major concerns in managing pasture.

The major soils are suited to building site development and some kinds of onsite waste disposal. A high shrink-swell potential, the wetness, and low strength are the major limitations. In some areas the slope is a limitation.

2. Keswick-Lindley-Gorin Association

Deep, moderately sloping to steep, well drained to somewhat poorly drained soils formed in glacial till or in loess and pedisediment; on uplands

This association consists of soils on narrow, meandering, convex ridgetops, dissected upper side slopes, and deep valley side slopes adjacent to the major drainageways. Slopes range from 5 to 30 percent.

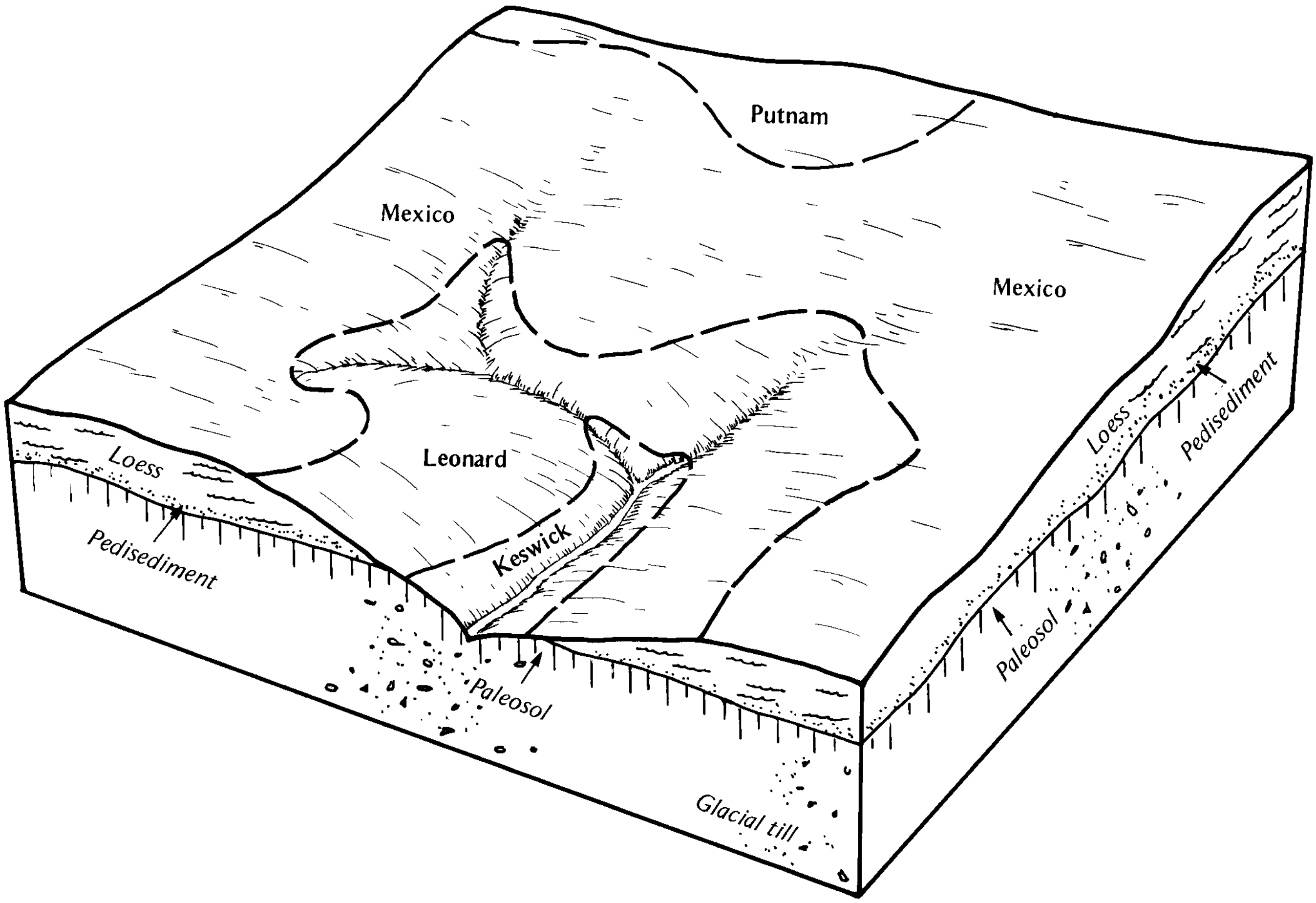

Figure 2.—Typical pattern of soils and parent material in the Mexico-Leonard-Putnam association.

This association makes up about 30 percent of the county. It is about 46 percent Keswick soils, 17 percent Lindley soils, 11 percent Gorin soils, and 26 percent minor soils (fig. 3).

Keswick soils are moderately sloping to moderately steep, are moderately well drained, and are on convex side slopes and ridgetops. Typically, the surface layer is dark brown silt loam. The subsoil is brown and mottled. It is clay in the upper part and clay loam in the lower part.

Lindley soils are moderately steep and steep, are well drained, and are on highly dissected side slopes along the major drainageways. Typically, the surface layer is very dark grayish brown loam. The subsurface layer is brown loam. The subsoil is yellowish brown. It is clay loam in the upper part and mottled loam in the lower part. The substratum is yellowish brown, mottled loam.

Gorin soils are moderately sloping, are somewhat poorly drained, and are on narrow, convex ridgetops and foot slopes. Typically, the surface layer is dark grayish brown silt loam. The subsoil is yellowish brown silty clay loam and silty clay in the upper part; brown, mottled silty clay loam in the next part; and brown and yellowish brown, mottled clay loam and clay in the lower part.

Minor in this association are the poorly drained Moniteau soils on low stream terraces, the moderately deep Gosport soils on the lower valley side slopes along the major drainageways, the nearly level Wilbur soils on narrow flood plains, and the gently sloping Calwoods soils on broad, convex ridgetops.

This association is used mainly for pasture, hay, or woodland. Some of the ridgetops and less sloping areas are used for cultivated crops. Because of the slope and a severe hazard of erosion, the major soils generally are unsuited to cultivated crops. They generally are suited to pasture and hay. The slope, the hazard of erosion, overgrazing, and grazing when the soils are wet are the main concerns in managing pasture.

Many areas support mixed hardwoods. The major soils are suited to woodland. The slope, the hazard of erosion along skid trails and logging roads, and seasonal wetness are the main management concerns.

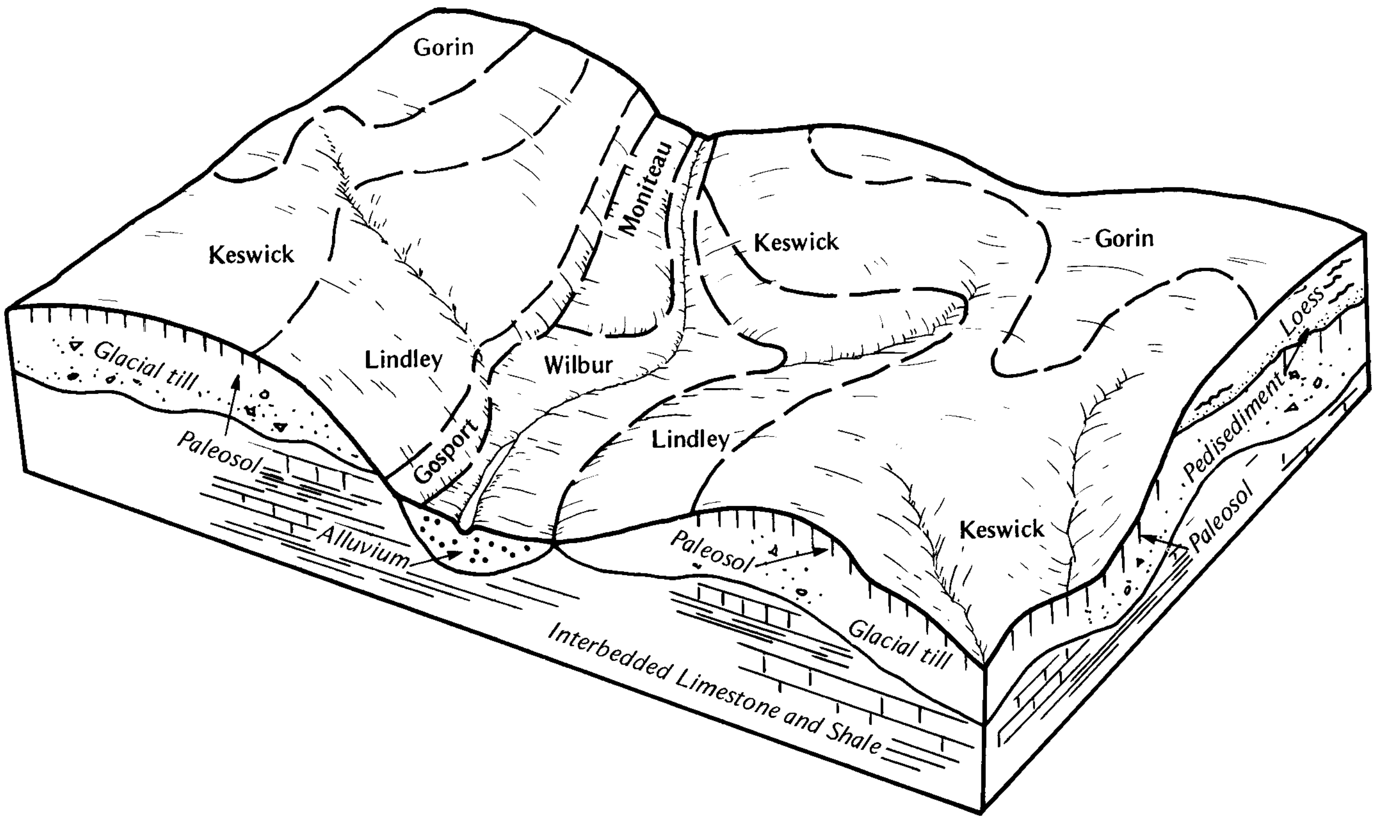

Figure 3.—Typical pattern of soils and parent material in the Keswick-Lindley-Gorin association.

The Keswick and Lindley soils generally are unsuited to building site development and most kinds of onsite waste disposal because of the slope, the wetness, and a high shrink-swell potential. The Gorin soils are suited to building site development and some kinds of onsite waste disposal, but wetness, slow permeability, and a high shrink-swell potential are limitations.

3. Gosport-Gorin Association

Moderately deep and deep, moderately sloping to steep, moderately well drained and somewhat poorly drained soils formed in shale residuum or in loess and pedisediment; on uplands

This association consists of soils on narrow, meandering, convex ridgetops and deep valley side slopes adjacent to the major drainageways. Limestone ledges crop out on some of the side slopes. Slopes range from 5 to 30 percent.

This association makes up about 19 percent of the county. It is about 43 percent Gosport soils, 23 percent Gorin soils, and 34 percent minor soils.

Gosport soils are moderately deep, moderately steep and steep, and moderately well drained. They are on highly dissected side slopes. Typically, the surface layer is very dark grayish brown silt loam. The subsurface layer is brown silt loam. The subsoil is silty clay. It is yellowish brown and mottled in the upper part and light olive brown in the lower part. Multicolored, weathered clayey shale bedrock is at a depth of about 36 inches.

Gorin soils are deep, moderately sloping, and somewhat poorly drained. They are on narrow, convex ridgetops and foot slopes. Typically, the surface layer is dark grayish brown silt loam. The subsoil is yellowish brown silty clay loam and silty clay in the upper part; brown, mottled silty clay loam in the next part; and brown and yellowish brown, mottled clay loam and clay in the lower part.

Minor in this association are the Keswick soils on the upper side slopes and at the head of small drainageways; the shallow, well drained Norris Variant soils on the lower, dissected side slopes; and the poorly drained Piopolis soils on flood plains.

This association is used mainly for woodland. Some of the less sloping ridgetops and foot slopes are used for pasture, hay, or cultivated crops. The Gorin soils are suitable for cultivated crops and for pasture and hay.

The Gosport soils generally are unsuitable, however, because of the slope, the hazard of erosion, and the bedrock outcrops.

The native vegetation was mixed hardwoods. The major soils are suited to woodland. Windthrow, seedling mortality, and the equipment limitation are management concerns. The use of equipment is limited by the slope and the rock outcrops.

The Gosport soils generally are unsuited to building site development and sanitary facilities because of the slope, the rock outcrops, and a high shrink-swell potential. The Gorin soils are suited to building site development and some kinds of onsite waste disposal, but wetness, slow permeability, and a high shrink-swell potential are limitations.

4. Keswick-Lagonda Association

Deep, moderately sloping, moderately well drained and somewhat poorly drained soils formed in glacial till or in loess and pedisediment; on uplands

This association consists of soils on narrow, convex ridgetops and on convex side slopes dissected by small, winding drainageways and narrow flood plains. Slopes range from 5 to 9 percent.

This association makes up about 15 percent of the county. It is about 52 percent Keswick soils, 35 percent Lagonda and similar soils, and 13 percent minor soils (fig. 4).

Keswick soils are moderately well drained. They are on the lower side slopes. Typically, the surface layer is dark grayish brown silt loam. The subsoil is pale brown and grayish brown, mottled clay in the upper part and light brownish gray, mottled clay loam in the lower part. The substratum also is light brownish gray, mottled clay loam.

Lagonda soils are somewhat poorly drained and are on narrow, convex ridgetops and the upper side slopes. Typically, the surface layer is very dark grayish brown silt loam. The subsoil is dark grayish brown, mottled silty clay loam and silty clay in the upper part and dark

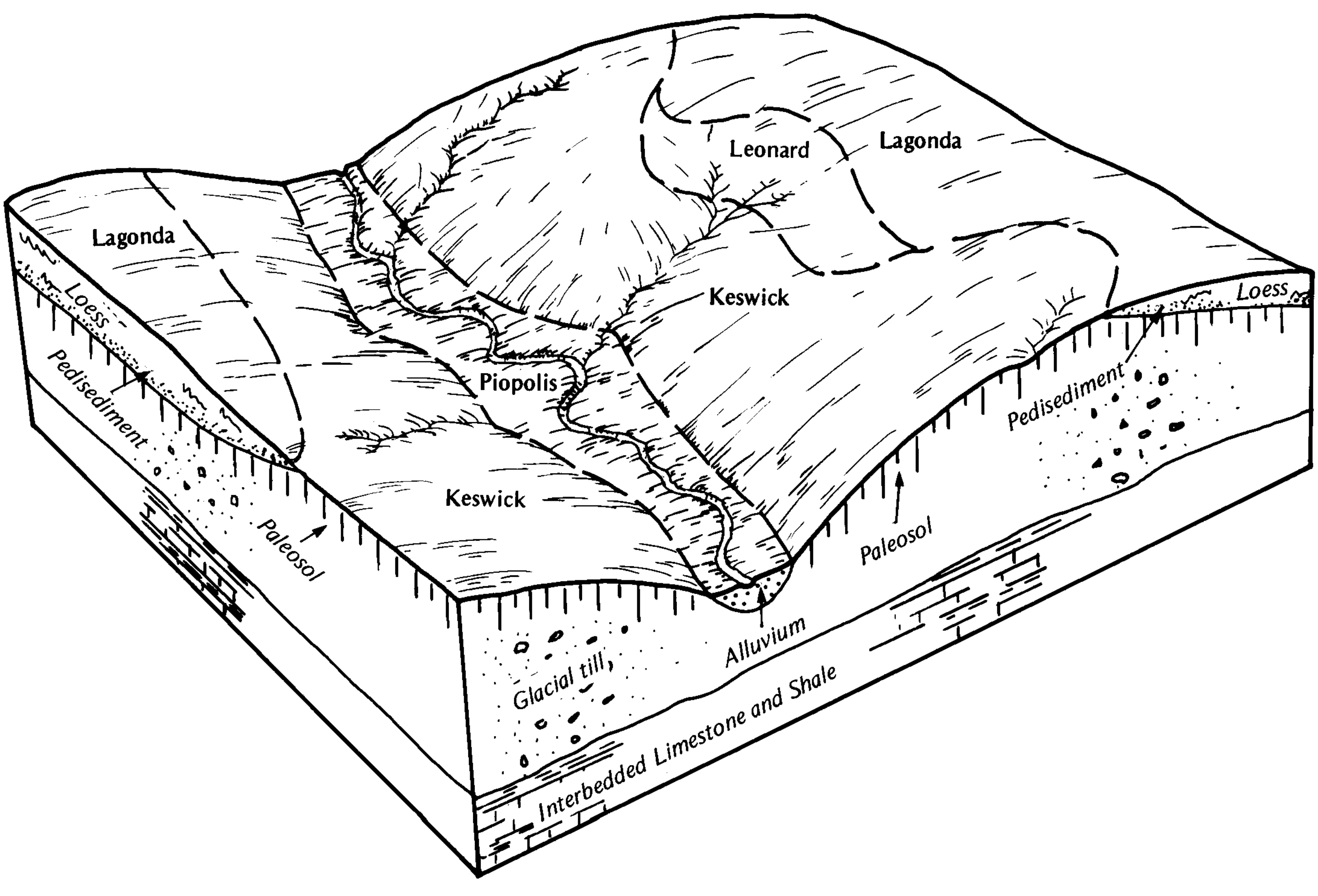

Figure 4.—Typical pattern of soils and parent material in the Keswick-Lagonda association.

grayish brown and grayish brown, mottled silty clay loam and clay loam in the lower part. The substratum is grayish brown, mottled clay loam.

Minor in this association are the poorly drained, nearly level Piopolis soils on narrow flood plains and the poorly drained Leonard soils at the head of drainageways.

This association is used mainly for cultivated crops, pasture, or hay. The major soils are suited to corn, soybeans, and wheat. The hazard of accelerated erosion is the main management concern. These soils are suited to water-tolerant grasses and legumes for pasture and hay. Seasonal wetness, the hazard of erosion, the slope, and overgrazing are the main concerns in managing pasture and hayland.

Many of the steeper areas and wetter flood plains support native timber. The major soils are suited to woodland. The hazard of erosion, the equipment limitation, and the windthrow hazard are the main management concerns.

The major soils generally are suited to building site development and most kinds of onsite waste disposal. The wetness, a high shrink-swell potential, slow permeability, and the slope are the major limitations.

5. Piopolis-Chequest Association

Deep, nearly level, poorly drained soils formed in silty or clayey alluvium; on flood plains

This association consists of soils on broad flood plains along the major streams. Differences in elevation are slight. The highest points are adjacent to the original meandering stream channels. The Piopolis soils generally are in the higher landscape positions, and the Chequest soils are in the lower ones. Slopes range from 0 to 2 percent.

This association makes up about 6 percent of the county. It is about 63 percent Piopolis soils, 17 percent Chequest soils, and 20 percent minor soils (fig. 5).

Piopolis soils are on natural levees along the major stream channels. They occupy the entire flood plain in some small tributary valleys. Typically, the surface layer is dark grayish brown silty clay loam. The substratum is dark gray, mottled silty clay loam.

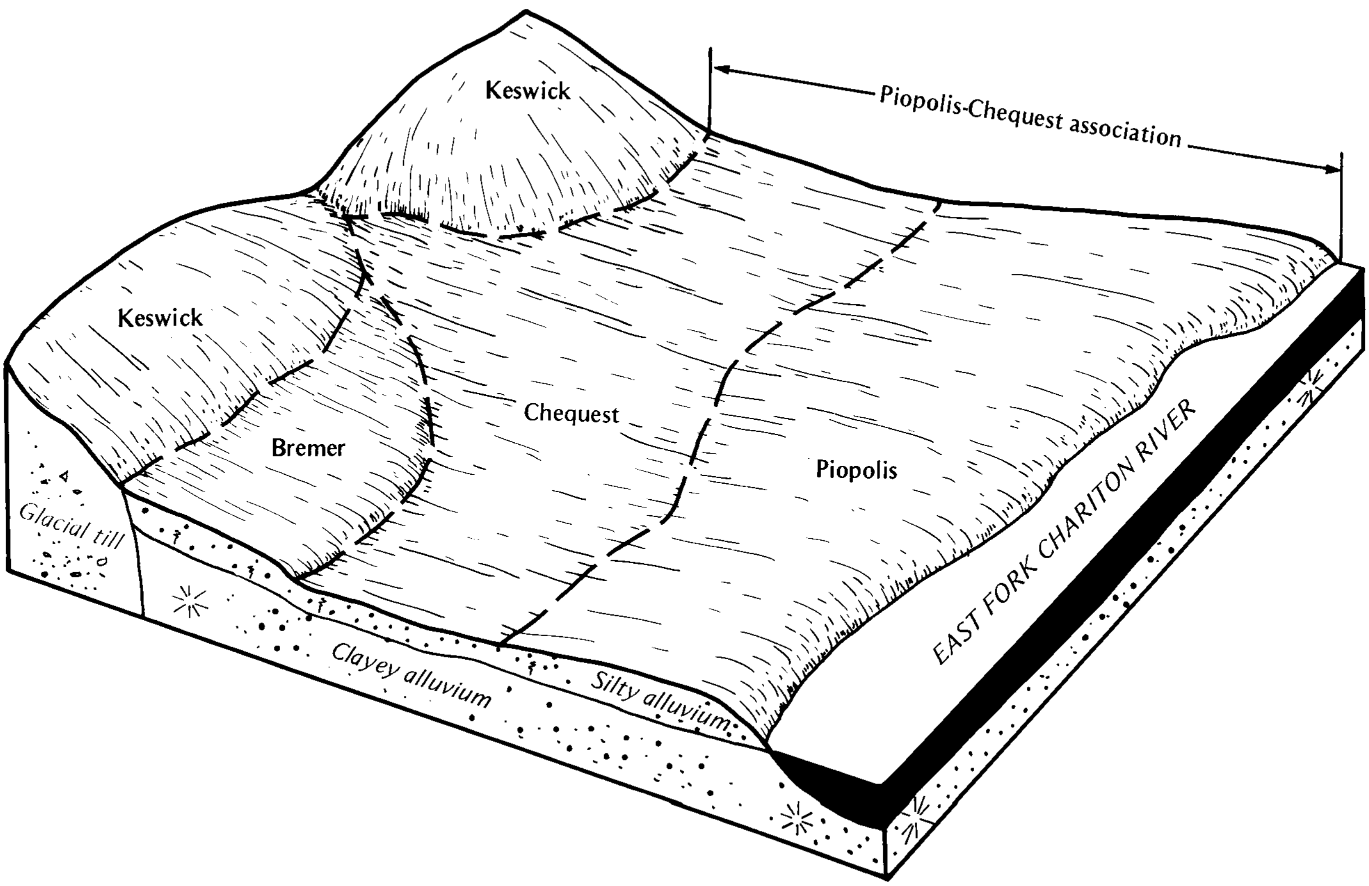

Figure 5.—Typical pattern of soils and parent material in the Piopolis-Chequest association.

Chequest soils are in low drainageways and broad depressions on flood plains along the major streams. Typically, the surface layer is very dark gray silty clay loam. The subsurface layer is very dark gray, mottled silty clay loam. The subsoil is dark gray, mottled silty clay loam.

Minor in this association are the Bremer and Moniteau soils on low stream terraces. Bremer soils are adjacent to the broader flood plains, and Moniteau soils are adjacent to the narrower flood plains.

This association is used mainly for cultivated crops. Some small areas are used for pasture or hay. The major soils are suited to corn, soybeans, and wheat. Wetness and flooding are the main management concerns.

The major soils generally are unsuited to building site development and onsite waste disposal because of the flooding.

6. Bethesda-Schuline Association

Deep, gently sloping to very steep, well drained soils formed in material mixed by surface mining activities; on uplands

This association consists of soils in areas that have been surface mined for coal. Some areas have irregularly shaped spoil piles and water-filled pits, and other areas have been graded and smoothed. Topsoil has been replaced in some of the graded and smoothed areas. Slopes range from 3 to 70 percent.

This association makes up about 4 percent of the county. It is about 64 percent Bethesda soils, 21 percent Schuline soils, and 15 percent minor soils.

Bethesda soils are strongly sloping to very steep. They are on narrow, parallel spoil piles, some of which have been graded and smoothed. Typically, the surface layer is grayish brown shaly silt loam. The substratum is brownish yellow, strong brown, and yellowish brown very shaly clay loam. The content of shale, limestone, siltstone, and sandstone fragments is 35 to 60 percent in the substratum.

Schuline soils are gently sloping to strongly sloping. They are on ridgetops and side slopes. Typically, the surface layer is mixed dark brown and yellowish brown silty clay loam. The substratum is mixed dark yellowish brown and yellowish brown clay loam in the upper part and mixed grayish brown, dark grayish brown, and yellowish brown silty clay loam in the lower part.

Minor in this association are the moderately well drained Keswick and Gosport soils and the somewhat poorly drained Gorin soils. Keswick soils formed in glacial till on side slopes and at the head of drainageways. The moderately deep Gosport soils formed in shaly residuum on the lower side slopes. Gorin soils formed in loess and pedisediment on the tops of the higher ridges.

This association is used mainly for pasture, hay, or woodland. Because of the slope, a severe hazard of erosion, droughtiness, and large stones, the Bethesda soils generally are unsuited to cultivated crops. In areas that have been graded and smoothed, they are suited to grasses and legumes for pasture. The Schuline soils are suited to corn, soybeans, wheat, and most grasses and legumes. The hazard of erosion is the main management concern in cultivated areas. The hazard of erosion, overgrazing, and high acidity are the main concerns in managing pasture.

The major soils are suited to woodland. Species that can withstand high acidity, droughtiness, and a restricted root zone can be grown on the Bethesda soils. Seedling mortality, windthrow, plant competition, and the equipment limitation are management concerns.

The Bethesda soils generally are unsuited to building site development and sanitary facilities, mainly because of the slope. The Schuline soils are suited to building site development and some kinds of onsite waste disposal, but the slope, slow permeability, and the shrink-swell potential are limitations.

Detailed Soil Map Units

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

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

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

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

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Keswick silt loam, 5 to 9 percent slopes, eroded, is a phase of the Keswick series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Norris Variant-Gosport complex, 14 to 35 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. The Pits part of the Udorthents-Pits complex is an example. Miscellaneous areas are shown on the soil maps.

The descriptions, names, and delineations of the soils identified on the detailed soil maps in this survey do not fully agree with those of the soils identified on the maps of adjacent counties published at a different date. Differences are the result of additional soil data, variations in the intensity of mapping, and correlation decisions that reflect local conditions. In some areas combining small acreages of similar soils that respond to use and management in much the same way is more practical than mapping these soils separately.

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

Soil Descriptions

15B2—Calwoods silt loam, 2 to 5 percent slopes, eroded. This deep, gently sloping, somewhat poorly drained soil is on the tops of low ridges in the uplands. Individual areas are long and narrow and range from 15 to 100 acres in size.

Typically, the surface layer is dark grayish brown, very friable silt loam about 5 inches thick. The subsoil is about 41 inches thick. The upper part is brown, mottled, friable silty clay loam; the next part is dark grayish brown and grayish brown, mottled, very firm silty clay; and the lower part is grayish brown, mottled, firm silty clay loam. The substratum to a depth of 60 inches or more is grayish brown, mottled, firm silty clay loam. In some places the surface layer is very dark grayish brown silt loam more than 6 inches thick. In other places the subsoil is browner.

Permeability is very slow, and surface runoff is slow. Available water capacity is high. Natural fertility is medium, and organic matter content is moderately low. The shrink-swell potential is high. This soil tends to remain wet from late fall to early spring because of a perched water table at a depth of 1.0 to 2.5 feet.

Crusting and puddling can occur after periods of heavy rainfall, especially in areas where the plow layer contains subsoil material.

Most areas are used for hay and pasture or for cultivated crops. This soil is suited to corn, grain sorghum, soybeans, and winter wheat. Erosion has removed 4 to 6 inches of the original topsoil. If row crops are grown, further erosion is a hazard. It can be controlled by a system of conservation tillage that leaves protective amounts of crop residue on the surface, winter cover crops, terraces, underground tile outlets and grassed waterways, contour farming, and a conservation cropping system that includes grasses and legumes for hay or pasture.

This soil is well suited to ladino clover and moderately well suited to alsike clover, birdsfoot trefoil, reed canarygrass, big bluestem, and indiangrass. The species that can withstand the wetness grow best. Erosion during seedbed preparation is the main problem. Timely tillage and a quickly established ground cover help to prevent excessive soil loss.

Many areas support native hardwoods, dominantly good-quality white oak. This soil is suited to trees. Seedling mortality and windthrow are management concerns. Planting container-grown nursery stock can increase the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely. Windthrown trees should be periodically removed.

This soil is suitable for building site development, but the wetness and the high shrink-swell potential are limitations. The structural damage caused by shrinking and swelling can be minimized by using adequately reinforced concrete in properly designed footings, foundations, and basement walls and by providing additional reinforcement steel and expansion joints. A sand or gravel base for sidewalks and driveways helps to prevent the damage caused by shrinking and swelling and by frost action. Installing drainage tile around footings and foundations can help to prevent the damage caused by excessive wetness.

Because of the wetness and the very slow permeability, this soil generally is unsuited to septic tank absorption fields. Properly designed sewage lagoons can function adequately if the site is leveled.

Low strength is a limitation if this soil is used as a site for local roads and streets. The base can be strengthened by adding crushed rock or other suitable material or by mixing the soil with additives. Grading the roads and streets so that they can shed water and providing adequate roadside ditches and culverts can minimize the damage caused by shrinking and swelling, frost action, and wetness.

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

16C2—Lagonda silt loam, 5 to 9 percent slopes, eroded. This deep, moderately sloping, somewhat poorly drained soil is on narrow ridgetops and the upper side slopes in the uplands. Individual areas are irregular in shape and range from 25 to more than 150 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 34 inches thick. The upper part is dark grayish brown, mottled, friable silty clay loam and firm silty clay. The lower part is dark grayish brown and grayish brown mottled, firm silty clay loam and clay loam. The substratum to a depth of 60 inches or more is grayish brown, mottled, firm clay loam. In some places the dark surface layer is thicker. In other places the subsoil does not have any glacial sand or pebbles.

Included with this soil in mapping are small areas of the moderately well drained Keswick and poorly drained Leonard soils. These soils are on side slopes below the Lagonda soil. They make up about 8 percent of the unit.

Permeability is slow in the Lagonda soil. Surface runoff is medium in cultivated areas. Available water capacity is moderate. Natural fertility is high, and organic matter content is moderate. The shrink-swell potential is high. A perched water table, at a depth of 1.5 to 3.0 feet during wet periods, and the compact silty clay in the subsoil can restrict root development.

Most areas are used for cultivated crops (fig. 6). A few areas are used for pasture or hay. This soil is suited to corn, soybeans, and wheat. Erosion has removed 4 to 8 inches of the original topsoil. If cultivated crops are grown, further erosion is a hazard. It can be controlled by a system of conservation tillage that leaves protective amounts of crop residue on the surface, winter cover crops, terraces, underground tile outlets and grassed waterways, contour farming, and a conservation cropping system that includes grasses and legumes for pasture and hay. Most areas are smooth and are suitable for terracing and farming on the contour. Excess water in seepy areas can be removed by drainage tile. Returning crop residue to the soil or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration.

This soil is well suited to ladino clover and moderately well suited to tall fescue, timothy, lespedeza, birdsfoot trefoil, indiangrass, and switchgrass. The species that can withstand the wetness grow best. Erosion during seedbed preparation is the main problem. Timely tillage and a quickly established ground cover help to prevent excessive soil loss.

This soil is suited to building site development and some kinds of onsite waste disposal, but the high shrink-swell potential, the slow permeability, and the wetness are limitations. The structural damage caused by shrinking and swelling can be minimized by using adequately reinforced concrete in properly designed footings, foundations, and basement walls and by providing additional reinforcement steel and expansion

Figure 6.—Winter wheat in an area of Lagonda silt loam, 5 to 9 percent slopes, eroded. Gosport and Gorin soils are in the background.

joints. A sand or gravel base for sidewalks and driveways helps to prevent the damage caused by shrinking and swelling and by frost action. Installing drainage tile around footings and foundations can help to prevent the damage caused by excessive wetness. Sewage is best treated in a properly designed lagoon constructed in the less sloping areas.

Low strength, the high shrink-swell potential, and frost action are limitations on sites for local roads and streets. The base should be strengthened with suitable material. Grading the roads and streets so that they can shed water and providing adequate roadside ditches and culverts help to prevent the damage caused by shrinking and swelling, wetness, and frost action.

The land capability classification is IIIe. No woodland ordination symbol is assigned.

18C2—Gorin silt loam, 5 to 9 percent slopes, eroded. This deep, moderately sloping, somewhat poorly drained soil is on convex ridgetops and foot slopes in the uplands. Individual areas are long and narrow and range from 15 to 65 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 4 inches thick. The subsoil extends to a depth of 60 inches or more. The upper part is yellowish brown, friable silty clay loam and firm silty clay; the next part is brown, mottled, firm silty clay loam; and the lower part is brown and yellowish brown, mottled, firm clay loam and very firm clay. In some places the subsoil tends to be firm, massive, and brittle. In other places it is grayer. In some of the more sloping areas, the soil contains glacial sand and gravel throughout.

Permeability is slow, and surface runoff is medium. Available water capacity is high. Natural fertility and organic matter content are low. The shrink-swell potential is high. Root development is somewhat restricted by compactness in the lower part of the subsoil. This soil tends to remain wet from late fall to early spring, partly because of a perched water table at a depth of 2 to 4 feet.

Most areas are used for pasture, hay, or timber. Some of the larger areas, particularly those on the broader foot slopes, are used for cultivated crops. This soil is suited to corn, soybeans, and wheat. Erosion has removed 6 to 8 inches of the original topsoil. If cultivated crops are grown, further erosion is a hazard. It can be controlled by a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, and crop rotations that include grasses and legumes for hay and pasture. In many areas terracing is difficult because of complex slopes.

Although the available water capacity is high, insufficient soil moisture commonly retards the growth of row crops during the summer. If corn or grain sorghum are grown, high plant populations should be avoided. In its natural state, this soil is quite acid and is low in fertility. As a result, additions of lime and fertilizer are needed. Returning a considerable amount of crop residue to the soil helps to control erosion, improves fertility, and increases the rate of water infiltration.

This soil is well suited to ladino clover and moderately well suited to birdsfoot trefoil, crownvetch, tall fescue, timothy, big bluestem, and indiangrass. The species that can withstand the wetness grow best. Erosion during seedbed preparation is the main problem. Timely tillage and a quickly established ground cover help to prevent excessive soil loss.

Many areas support native hardwoods, dominantly good-quality white oak. This soil is suited to trees. Seedling mortality and windthrow are management concerns. Planting container-grown nursery stock can increase the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely. Windthrown trees should be periodically removed.

This soil is suited to building site development and some kinds of onsite waste disposal, but the high shrink-swell potential, the slow permeability, and the wetness are limitations. The structural damage caused by shrinking and swelling can be minimized by using adequately reinforced concrete in properly designed footings, foundations, and basement walls and by providing additional reinforcement steel and expansion joints. Installing drainage tile around footings and foundations can help to prevent the damage caused by excessive wetness. Septic tank absorption fields do not function well because of the wetness and the slow permeability. Sewage lagoons can function adequately if the site is leveled.

Low strength is a limitation if this soil is used as a site for local roads and streets. The base can be strengthened by adding crushed rock or other suitable material. Grading the roads and streets so that they can shed water and providing adequate roadside ditches and culverts can minimize the damage caused by shrinking and swelling, frost action, and wetness.

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

19E2—Gosport silt loam, 14 to 30 percent slopes, eroded. This moderately deep, moderately steep and steep, moderately well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from 30 to several hundred acres in size.

Typically, the surface layer is very dark grayish brown, very friable silt loam about 2 inches thick. The subsurface layer is brown, friable silt loam about 3 inches thick. The subsoil is firm silty clay about 31 inches thick. The upper part is yellowish brown and mottled, and the lower part is yellowish brown and light olive brown. Weathered shale bedrock is at a depth of about 36 inches. In some areas the surface layer is silty clay loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Gorin soils, the moderately well drained Keswick soils, the well drained Lindley soils, and the nearly level, moderately well drained Wilbur soils. The moderately sloping Gorin soils are on the higher ridgetops. Keswick and Lindley soils are on the higher side slopes. Wilbur soils are on narrow flood plains along small streams. Also included are some areas where limestone cobbles, stones, and boulders are on the surface and some areas where limestone and shale bedrock crops out on the steeper slopes adjacent to drainageways. Included areas make up about 10 percent of the unit.

Permeability is very slow in the Gosport soil, and surface runoff is rapid. Available water capacity is moderate. Natural fertility is low, and organic matter content is moderately low. The shrink-swell potential is high. The rooting depth is limited by the weathered bedrock at a depth of about 20 to 40 inches.

Most areas are used as woodland or pasture. Because of the slope and a severe hazard of erosion, this soil is generally unsuited to cultivated crops. It is moderately well suited to birdsfoot trefoil, lespedeza, red fescue, orchardgrass, big bluestem, and indiangrass. Shallow-rooted species that can withstand droughtiness should be selected for planting. Erosion has removed about half of the original topsoil in the pastured areas. It is a serious hazard when the pasture is seeded. Timely tillage and a quickly established ground cover help to prevent excessive soil loss.

Many areas support native hardwoods. This soil is suited to trees. White oak, black oak, and northern red oak grow well. Seedling mortality, windthrow, the erosion hazard, and the equipment limitation are management concerns. Planting container-grown nursery stock increases the seedling survival rate. The hazard of windthrow is severe because the bedrock restricts root penetration. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely. The slope severely limits the use of harvesting and planting equipment. Hand planting of seedlings may be necessary. Logging roads and skid trails should be constructed on the contour. In most of the existing stands, thinning and selective cutting of undesirable trees are needed. These measures improve the habitat for woodland wildlife, especially white-tailed deer and wild turkey.

This soil generally is unsuitable for building site development and most kinds of onsite waste disposal because of the slope, the depth to bedrock, and the high shrink-swell potential.

The land capability classification is VIIe. The woodland ordination symbol is 2R.

23C2—Keswick silt loam, 5 to 9 percent slopes, eroded. This deep, moderately sloping, moderately well drained soil is on ridgetops and side slopes in the uplands. Individual areas are irregular in shape and range from 25 to more than 150 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 6 inches thick. The subsoil is about 50 inches thick. The upper part is pale brown, light brownish gray, and grayish brown, mottled, firm clay, and the lower part is light brownish gray, mottled, very firm clay loam. The substratum to a depth of 60 inches or more also is light brownish gray, mottled, very firm clay loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Lagonda and poorly drained Leonard soils. Lagonda soils are on the higher, broader ridgetops. Leonard soils are in the higher areas at the head of drainageways. Included soils make up about 5 percent of the unit.

Permeability is slow in the Keswick soil, and surface runoff is medium. Available water capacity is moderate. Natural fertility is medium, and organic matter content is moderately low. The shrink-swell potential is high. A perched water table is at a depth of 1 to 3 feet from early winter to late spring.

Most areas are used for cultivated crops or for pasture and hay. A few areas are timbered. This soil is suited to corn, soybeans, and wheat. Erosion has removed about half of the original topsoil. If cultivated crops are grown, further erosion is a hazard. It can be controlled by a system of conservation tillage that leaves protective amounts of crop residue on the surface, winter cover crops, grassed waterways, contour farming, and a conservation cropping system that includes grasses and legumes for hay or pasture.

This soil is well suited to ladino clover and moderately well suited to alsike clover, crownvetch, reed canarygrass, tall fescue, big bluestem, and indiangrass. The species that can withstand the wetness grow best. Erosion during seedbed preparation is the main problem. Timely tillage and a quickly established ground cover help to prevent excessive soil loss.

A few areas support native hardwoods. This soil is suited to trees. White oak, northern red oak, and shagbark hickory grow well. The windthrow hazard and seedling mortality are management concerns. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely. Planting container-grown nursery stock can increase the seedling survival rate.

This soil is suitable for building site development and most kinds of onsite waste disposal, but the high shrink-swell potential, the wetness, and the slope are limitations. The structural damage caused by shrinking and swelling can be minimized by using adequately reinforced concrete in properly designed footings, foundations, and basement walls, by providing additional reinforcement steel and expansion joints, and by backfilling with sand or gravel. Installing drainage tile around footings and foundations can help to prevent the damage caused by excessive wetness.

The slow permeability and the wetness are limitations if this soil is used as a site for septic tank absorption fields. Sewage is best treated in a properly designed lagoon constructed in the less sloping areas. Some land grading may be necessary to modify the slope.

Low strength, the high shrink-swell potential, and frost action are limitations on sites for local roads and streets. The base should be strengthened with crushed rock or other suitable material. Grading the roads and streets so that they can shed water and providing adequate roadside ditches and culverts help to prevent the damage caused by shrinking and swelling, wetness, and frost action.

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

23E2—Keswick silt loam, 9 to 20 percent slopes, eroded. This deep, strongly sloping and moderately steep, moderately well drained soil is on convex side slopes in the uplands. Individual areas are irregular in shape and range from 25 to 300 acres in size.

Typically, the surface layer is dark brown, friable silt loam about 5 inches thick. The subsoil extends to a depth of more than 60 inches. It is brown and mottled. The upper part is firm clay, and the lower part is very firm clay loam. In places the upper 30 inches has no glacial sand and gravel.

Included with this soil in mapping are small areas of the well drained Lindley soils on the lower, steeper parts of the landscape and the poorly drained Leonard soils on the higher, less sloping parts. Included soils make up about 10 percent of the unit.

Permeability is slow in the Keswick soil, and surface runoff is medium or rapid. Available water capacity is moderate. Natural fertility is medium, and organic matter content is moderately low. The shrink-swell potential is high. This soil tends to remain wet from November to July, partly because of a perched water table at a depth of 1 to 3 feet.

Most areas are used for pasture, hay, or timber. This soil is unsuited to cultivated crops because of a severe hazard of erosion and the slope. Erosion has removed about half of the original topsoil.

This soil is well suited to ladino clover and moderately well suited to birdsfoot trefoil, lespedeza, redtop, tall fescue, big bluestem, and indiangrass. Erosion is the main problem. A protective ground cover is necessary at all times. Nurse crops help to control erosion in newly seeded areas. No-till seeding also helps to control erosion. The pasture should be tilled on the contour and in a timely manner. Overgrazing should be avoided.

Many areas support native hardwoods. This soil is suited to trees. White oak and northern red oak grow well. Because of the slope, erosion is a hazard and the use of planting and harvesting equipment is limited. Careful design of logging roads and skid trails can minimize the steepness and length of slopes and can prevent excessive concentration of water. Seeding may be necessary after harvesting activities are complete. Windthrow is a hazard in established stands. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely. Planting container-grown nursery stock increases the seedling survival rate.

This soil generally is unsuitable for building site development and most kinds of onsite waste disposal because the slope, the wetness, and the high shrink-swell potential are severe limitations. Overcoming these limitations is difficult and costly.

The land capability classification is VIe. The woodland ordination symbol is 3R.

24E—Norris Variant-Gosport complex, 14 to 35 percent slopes. These moderately steep and steep, well drained soils are on highly dissected side slopes in the uplands. The shallow Norris Variant soil is in the steeper areas. The moderately deep Gosport soil is on the higher side slopes. Individual areas are irregular in shape and range from 200 to 800 acres in size. They generally are about 60 percent Norris Variant soil and 25 percent Gosport soil. The two soils occur as areas so intricately mixed or so small that mapping them separately was not practical.

Typically, the surface layer of the Norris Variant soil is very dark grayish brown, very friable fine sandy loam about 3 inches thick. The substratum is yellowish brown, very friable loamy fine sand about 13 inches thick. Weathered, soft, fractured sandstone bedrock is at a depth of about 16 inches.

Typically, the surface layer of the Gosport soil is very dark grayish brown, friable silt loam about 2 inches thick. The subsoil is light yellowish brown and light olive brown, firm silty clay about 34 inches thick. Weathered, clayey shale bedrock is at a depth of about 36 inches.

Included with these soils in mapping are small areas of the somewhat poorly drained Gorin and moderately well drained Wilbur soils. Gorin soils are on narrow, meandering ridgetops. Wilbur soils are on narrow flood plains adjacent to small drainageways. Included soils make up about 15 percent of the unit.

Permeability is rapid in the Norris Variant soil and very slow in the Gosport soil. Surface runoff is medium on the Norris Variant soil and rapid on the Gosport soil. Available water capacity is low in the Norris Variant soil and moderate in the Gosport soil. Natural fertility is low in both soils, and organic matter content is moderately low. The shrink-swell potential is high in the Gosport soil. The rooting depth is limited by the bedrock underlying both soils.

Nearly all areas are used as woodland. Some of the less sloping areas support grasses and legumes for pasture. Because of the slope and a severe hazard of erosion, these soils are unsuited to cultivated crops. They are suited to grasses and legumes for hay or pasture only in the less sloping areas. They are poorly suited to alsike clover, big bluestem, little bluestem, and indiangrass, but these species produce more forage than other species. Shallow-rooted species that can withstand droughtiness should be selected for planting. Erosion is a serious hazard in newly seeded areas. Timely tillage and a quickly established ground cover help to prevent excessive soil loss.

Many areas support native hardwoods. These soils are suited to trees. Black oak and northern red oak grow well. Seedling mortality, windthrow, the erosion hazard, and the equipment limitation are management concerns. Hand planting of container-grown nursery stock increases the seedling survival rate. The sandstone or shale bedrock restricts root penetration and results in a severe windthrow hazard. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely. The slope limits the use of harvesting and planting equipment. Logging roads and skid trails should be constructed on the contour. In most of the stands, thinning and selective cutting of undesirable trees are needed. These measures improve the habitat for woodland wildlife, especially white-tailed deer and wild turkey.

These soils generally are unsuitable for building site development and most sanitary facilities because of the slope and the depth to bedrock.

The land capability classification is VIIe. The woodland ordination symbol assigned to the Norris Variant soil is 2R, and that assigned to the Gosport soil is 3R.

26B2—Leonard silt loam, 2 to 6 percent slopes, eroded. This deep, gently sloping, poorly drained soil is on concave side slopes and at the head of drainageways in the uplands. Individual areas are irregular in shape and range from 15 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 7 inches thick. The subsoil is about 53 inches thick. The upper part is dark grayish brown, mottled, friable silty clay loam. The lower part is gray, mottled, firm and very firm silty clay that has fine white chert fragments. In some severely eroded areas, the surface layer is dark grayish brown silty clay loam. In places the subsoil does not have fine white chert fragments in the lower part.

Included with this soil in mapping are small areas of the moderately well drained Keswick soils on the lower side slopes. These soils make up about 10 percent of the unit.

Permeability is slow in the Leonard soil, and surface runoff is medium. Available water capacity is moderate. Natural fertility is medium, and organic matter content is moderate. The shrink-swell potential is high. A perched water table is at a depth of 0.5 foot to 2.0 feet during winter and spring.

Most areas are used for cultivated crops or for hay and pasture. This soil is suited to corn, soybeans, and wheat. Erosion has removed 3 to 4 inches of the original topsoil. If cultivated crops are grown, further erosion is a hazard. It can be controlled by a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, contour farming, stripcropping, and a combination of terraces and suitable outlets. A few areas have slopes that are long enough and smooth enough to be terraced and farmed on the contour. Returning crop residue to the soil improves tilth and fertility and increases the rate of water infiltration.

This soil is moderately well suited to reed canarygrass and switchgrass and moderately suited to alsike clover, birdsfoot trefoil, tall fescue, big bluestem, and indiangrass. Water-tolerant, shallow-rooted species grow best. Erosion during seedbed preparation is the major problem. Timely tillage and a quickly established ground cover help to prevent excessive soil loss. Restricted use during wet periods keeps the pasture in good condition.

This soil is suitable for building site development, but the wetness and the high shrink-swell potential are limitations. The structural damage caused by shrinking and swelling can be minimized by using adequately reinforced concrete in properly designed footings, foundations, and basement walls and by providing additional reinforcement steel and expansion joints. A sand or gravel base helps to prevent the damage caused by shrinking and swelling on sites for sidewalks and driveways. Installing drainage tile around footings and foundations can help to prevent the damage caused by excessive wetness.

This soil generally is unsuited to septic tank absorption fields because of the slow permeability and the slope. Properly designed sewage lagoons can function adequately if the site is leveled.

Low strength is a limitation if this soil is used as a site for local roads and streets. The base can be strengthened by adding crushed rock or other suitable material. Grading the roads and streets so that they can shed water and providing adequate roadside ditches and culverts can minimize the damage caused by shrinking and swelling, frost action, and wetness.

The land capability classification is IIIe. No woodland ordination symbol is assigned.

27E—Lindley loam, 14 to 30 percent slopes. This deep, moderately steep and steep, well drained soil is on highly dissected, uneven side slopes in the uplands. Individual areas are irregular in shape and range from 25 to 500 acres in size.

Typically, the surface layer is very dark grayish brown, very friable loam about 4 inches thick. The subsurface layer is brown, friable loam about 4 inches thick. The subsoil is about 41 inches thick. It is yellowish brown and firm. It is clay loam in the upper part and mottled loam in the lower part. The substratum to a depth of 60 inches or more is yellowish brown, mottled, firm loam. In places the subsoil contains more clay.

Included with this soil in mapping are small areas of the moderately well drained Keswick and Gosport soils and the somewhat poorly drained Gorin soils. Keswick soils are on the higher side slopes. The moderately deep Gosport soils are on the lower side slopes. Gorin soils are on narrow ridgetops at the higher elevations. Included soils make up about 10 percent of the unit.

Permeability is moderately slow in the Lindley soil, and surface runoff is rapid. Available water capacity is high. Natural fertility is medium, and organic matter content is moderately low. The shrink-swell potential is moderate.

Most areas remain wooded. A few are used for pasture and hay. Because of the slope and the hazard of erosion, this soil is unsuited to cultivated crops. It should be tilled only when it is seeded to pasture species. It is well suited to birdsfoot trefoil, crownvetch, red fescue, redtop, and switchgrass and moderately well suited to indiangrass. Erosion during seedbed preparation and overgrazing are the main management concerns. Preparing the seedbed on the contour and in a timely manner helps to ensure rapid growth of a good ground cover. Overgrazing should be avoided. Measures that maintain fertility and control brush are necessary.

Many areas support native hardwoods. This soil is suited to trees. White oak, northern red oak, and black oak grow well. Because of the slope, erosion is a hazard and the use of planting and harvesting equipment is limited. Logging roads and skid trails should be built on the contour. Seeding may be necessary after harvesting activities are complete. Undesirable trees in most of the established stands can be removed by selective cutting and thinning. Measures that protect new stands from fire and grazing are needed. These measures improve the habitat for woodland wildlife, especially white-tailed deer and wild turkey.

This soil generally is unsuitable for building site development and onsite waste disposal because the slope and the moderately slow permeability are severe limitations. Overcoming these limitations is difficult and costly.

The land capability classification is VIIe. The woodland ordination symbol is 3R.

30B—Mexico silt loam, 1 to 4 percent slopes. This deep, very gently sloping and gently sloping, somewhat poorly drained soil is on broad ridgetops and side slopes in the uplands. Individual areas are irregular in shape and range from 75 to 1,000 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 8 inches thick. The next 3 inches is mixed dark grayish brown and grayish brown, mottled, friable silty clay loam and very dark grayish brown, friable silt loam. The subsoil is about 42 inches thick. The upper part is dark grayish brown, mottled, firm and very firm silty clay; the next part is grayish brown, mottled, very firm silty clay; and the lower part is gray, mottled, very firm silty clay loam. The substratum to a depth of 60 inches or more is gray, mottled, firm silty clay loam. In places erosion has removed the original surface layer, exposing subsoil material of dark grayish brown silty clay loam or silty clay. In some areas the lower part of the substratum has small chert fragments. In other areas the dark surface layer is less than 6 inches thick.

Included with this soil in mapping are small areas of the nearly level Putnam soils on the higher, broad upland divides. These soils make up about 10 percent of the unit.

Permeability is very slow in the Mexico soil, and surface runoff is medium. Available water capacity is moderate. The surface layer can be easily tilled throughout a fairly wide range in moisture content. It tends to crust or puddle, however, after periods of heavy rainfall, especially in areas where the plow layer contains subsoil material. Natural fertility is medium, and organic matter content is moderate. The shrink-swell potential is high. A perched water table is at a depth of 1.0 to 2.5 feet during winter and spring. Root development is somewhat restricted by the silty clay in the subsoil.

Most areas are used for cultivated crops or for hay and pasture. This soil is suited to corn, soybeans, and wheat. If cultivated crops are grown, erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves protective amounts of crop residue on the surface (fig. 7), winter cover crops, terraces, underground tile outlets and grassed waterways, contour farming, and a conservation cropping system that includes grasses and legumes for hay or pasture.

This soil is well suited to ladino clover and moderately well suited to tall fescue, timothy, lespedeza, birdsfoot trefoil, indiangrass, and switchgrass. The species that can withstand the wetness grow best. Erosion during seedbed preparation is the main problem. Timely tillage and a quickly established ground cover help to prevent excessive soil loss.

This soil is suitable for building site development, but the wetness and the high shrink-swell potential are limitations. The structural damage caused by shrinking and swelling can be minimized by using adequately reinforced concrete in properly designed footings, foundations, and basement walls, by providing additional reinforcement steel and expansion joints, and by backfilling with sand or gravel. A sand or gravel base for sidewalks and driveways helps to prevent the damage caused by shrinking and swelling and by frost action. Installing drainage tile around footings and foundations can help to prevent the damage caused by excessive wetness.

Because of the wetness and the very slow permeability, this soil generally is unsuited to septic tank absorption fields. Properly designed sewage lagoons can function adequately. In some areas land shaping is needed to modify the slope prior to construction.

Low strength is a limitation if this soil is used as a site for local roads and streets. The base can be strengthened by adding crushed rock or other suitable material. Building the roads and streets on raised, well compacted fill material and providing adequate roadside ditches and culverts can minimize the damage caused by shrinking and swelling, frost action, and wetness.

The land capability classification is IIe. No woodland ordination symbol is assigned.

31—Putnam silt loam. This deep, nearly level, poorly drained soil is on broad upland divides. Individual areas are irregular in shape and range from 25 to about 400 acres in size.

Typically, the surface layer is very dark grayish brown, very friable silt loam about 10 inches thick. The subsurface layer is grayish brown, mottled, very friable silt loam about 7 inches thick. The subsoil is about 37 inches thick. The upper part is dark gray and grayish brown, mottled, firm silty clay, and the lower part is grayish brown, mottled, firm silty clay loam. The substratum to a depth of 60 inches or more is gray, mottled, firm silty clay loam. In places the surface layer is dark grayish brown.

Figure 7.—A protective cover of crop residue in an area of Mexico silt loam, 1 to 4 percent slopes.

Included with this soil in mapping are small areas of the gently sloping, somewhat poorly drained Mexico soils on the lower side slopes. These soils make up about 10 percent of the unit.

Permeability is very slow in the Putnam soil, and surface runoff is slow. Available water capacity is high. The hazard of crusting and puddling after periods of heavy rainfall is severe, especially in areas where the plow layer contains subsoil material. Natural fertility is medium, and organic matter content is moderate. The shrink-swell potential is high. A perched water table is at a depth of 0.5 foot to 1.5 feet during most winter and spring months.

Most areas are used for cultivated crops or for hay and pasture. This soil is suited to corn, soybeans, and wheat. The major limitation is the wetness. Returning crop residue to the soil helps to maintain the organic matter content. If the area is large enough, shallow surface ditches and some land grading can help to remove excess water.

This soil is moderately well suited to birdsfoot trefoil, reed canarygrass, and switchgrass. The species that can withstand the wetness grow best. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Small ditches and land grading improve surface drainage and thus help to prevent the damage to perennial plants caused by frost action.

This soil is suitable for building site development, but the wetness and the high shrink-swell potential are limitations. The structural damage caused by shrinking and swelling can be minimized by using adequately reinforced concrete in properly designed footings, foundations, and basement walls, by providing additional reinforcement steel and expansion joints, and by backfilling with sand or gravel. A sand or gravel base helps to prevent the damage caused by shrinking and swelling on sites for sidewalks and driveways. Installing drainage tile around footings and foundations can help to prevent the damage caused by excessive wetness. Land shaping can improve surface drainage.

Because of the wetness and the very slow permeability, this soil generally is unsuited to septic tank absorption fields. Properly designed sewage lagoons can function adequately.

Low strength is a limitation if this soil is used as a site for local roads and streets. The base can be strengthened by adding crushed rock or other suitable material. Building the roads and streets on raised, well compacted fill material and providing adequate roadside ditches and culverts can minimize the damage caused by shrinking and swelling, frost action, and wetness.

The land capability classification is IIw. No woodland ordination symbol is assigned.

34B—Grundy silt loam, 2 to 5 percent slopes. This deep, gently sloping, somewhat poorly drained soil is on the broad, convex tops of ridges in the uplands. Individual areas are irregular in shape and range from about 20 to 125 acres in size.

Typically, the surface layer is very dark grayish brown, very friable silt loam about 10 inches thick. The subsurface layer is very dark grayish brown, friable silt loam about 6 inches thick. The subsoil is about 40 inches thick. The upper part is dark grayish brown, mottled, firm silty clay. The next part is mixed dark grayish brown and grayish brown, mottled, firm silty clay. The lower part is dark grayish brown and grayish brown, mottled, firm silty clay loam. The substratum to a depth of 60 inches or more is light olive gray, mottled, firm clay loam. In some eroded areas the dark surface layer is less than 10 inches thick.

Permeability is slow, and surface runoff is medium. Available water capacity is high. Natural fertility also is high, and organic matter content is moderate. The shrink-swell potential is high. A perched water table is commonly at a depth of 1 to 3 feet during extended wet periods.

Most areas are used for cultivated crops, hay, or pasture. This soil is suited to corn, soybeans, and wheat. If cultivated crops are grown, erosion is a hazard. It can be controlled by a system of conservation tillage that leaves a protective cover of crop residue on the surface, stripcropping, winter cover crops, terraces, and a combination of grassed waterways and underground tile outlets. Leaving crop residue on the fields throughout the winter helps to protect the surface from erosive rains. Returning crop residue to the soil or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration.

This soil is well suited to most of the commonly grown legumes, such as ladino clover and lespedeza; cool-season grasses, such as tall fescue and reed canarygrass; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. The species that can withstand the wetness grow best. Erosion during seedbed preparation is the main management concern. Timely tillage and a quickly established ground cover help to prevent excessive soil loss.

This soil is suited to building site development, but the high shrink-swell potential and the wetness are limitations. The structural damage caused by shrinking and swelling can be minimized by using adequately reinforced concrete in properly designed footings, foundations, and basement walls and by providing additional reinforcement steel and expansion joints. Installing drainage tile around footings and foundations can help to prevent the damage caused by excessive wetness.

Because of the wetness and the slow permeability, this soil generally is unsuited to septic tank absorption fields. Sewage lagoons function adequately if the site is leveled.

Low strength, the high shrink-swell potential, and frost action are limitations on sites for local roads and streets. The base should be strengthened with crushed rock or other suitable material. Grading the roads and streets so that they can shed water and providing adequate roadside ditches and culverts help to prevent the damage caused by shrinking and swelling, wetness, and frost action.

The land capability classification is IIe. No woodland ordination symbol is assigned.

42—Bremer silt loam. This deep, nearly level, poorly drained soil is on low stream terraces. In low areas it is subject to rare flooding. Individual areas are irregular in shape and range from 15 to 50 acres in size.

Typically, the surface layer is very dark gray, friable silt loam about 8 inches thick. The subsurface layer is black, mottled, firm silty clay loam about 10 inches thick. The subsoil is about 28 inches thick. The upper part is very dark gray, mottled, firm silty clay loam, and the lower part is gray, mottled, very firm silty clay. The substratum to a depth of 60 inches or more is gray, mottled, very firm silty clay loam.

Included with this soil in mapping are small areas of Moniteau soils. These soils are lighter colored than the

Bremer soil. They are on the lower terraces. They make up less than 10 percent of the unit.

Permeability is moderately slow in the Bremer soil, and surface runoff is slow. Available water capacity is high. Natural fertility, organic matter content, and the shrink-swell potential also are high. A seasonal high water table is at a depth of 1 to 2 feet during most winter and spring months.

Most areas are cultivated. A few are used as pasture or hayland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. The wetness is the major management concern. Diversions at the base of the adjacent upland slopes help to keep excess water from moving onto this soil. Surface drains also help to remove excess water. The excess water is not likely to affect the yield of hay, pasture, or trees.

Pasture and hay mixtures that include water-tolerant varieties grow well on this soil. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the high water table. Proper stocking rates and deferment of grazing during wet periods help to keep the pasture in good condition.

This soil is suited to trees. Seedling mortality, the windthrow hazard, and the equipment limitation are the main management concerns. Planting container-grown nursery stock increases the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely. Equipment should be used only when the soil is firm or dry.

This soil generally is unsuited to building site development and onsite waste disposal because of the flooding, the high shrink-swell potential, the wetness, and the moderately slow permeability.

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

45A—Moniteau silt loam, 0 to 3 percent slopes. This deep, nearly level and very gently sloping, poorly drained soil is on low stream terraces. In low areas it is subject to rare flooding. Individual areas are irregular in shape and range from 15 to 80 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsurface layer is light brownish gray, friable silt loam about 8 inches thick. The subsoil is mottled silty clay loam about 34 inches thick. The upper part is grayish brown and friable, and the lower part is light brownish gray and firm. The substratum to a depth of 60 inches or more is light brownish gray, mottled, firm silty clay loam.

Included with this soil in mapping are small areas of the moderately well drained Wilbur soils. These soils are in the slightly lower areas adjacent to the natural stream channels. They make up less than 10 percent of the unit.

Permeability is moderately slow in the Moniteau soil, and surface runoff is slow. Available water capacity is high. Natural fertility is low, and organic matter content is moderately low. A perched water table is within a depth of 1 foot during most winter and spring months.

Most areas are used for cultivated crops (fig. 8). This soil is suited to corn, soybeans, and wheat. The wetness is the main limitation. Shallow surface drains, land grading, and timely tillage are necessary. The soil should be tilled only when the moisture content is optimum. Returning crop residue to the soil improves fertility and helps to maintain tilth.

A few small areas are used for hay and pasture. This soil is well suited to reed canarygrass; moderately well suited to tall fescue, timothy, birdsfoot trefoil, red clover, and switchgrass; and moderately suited to big bluestem. The perched water table is the main problem. It should affect the selection of species for planting. A drainage system is beneficial, especially if deep-rooted species are grown. A seedbed can be easily prepared.

Some areas support small stands of native hardwoods. This soil is suited to trees. The equipment limitation, seedling mortality, and the windthrow hazard are concerns in planting and harvesting trees. Equipment should be used only when the soil is dry and firm or during winter, when the ground is frozen. Planting container-grown nursery stock increases the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil generally is unsuited to building site development and onsite waste disposal because of the flooding.

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

51—Wilbur silt loam. This deep, nearly level, moderately well drained soil is on flood plains along creeks and small rivers. It is frequently flooded for brief periods. Individual areas are long and narrow and range from about 25 to 125 acres in size.

Typically, the surface layer is dark grayish brown, very friable silt loam about 7 inches thick. The substratum to a depth of 60 inches or more is mottled silt loam. The upper part is dark grayish brown and very friable, and the lower part is stratified brown, dark grayish brown, and grayish brown and is friable. In some areas adjacent to the natural stream channels, the soil contains more sand.

Included with this soil in mapping are small areas of the poorly drained Moniteau soils. These soils are on the slightly higher stream terraces. They make up about 10 percent of the unit.

Permeability is moderate in the Wilbur soil, and surface runoff is slow. Available water capacity is very high. Natural fertility is medium, and organic matter content is moderately low. A seasonal high water table is at a depth of 1.5 to 3.0 feet during the spring.

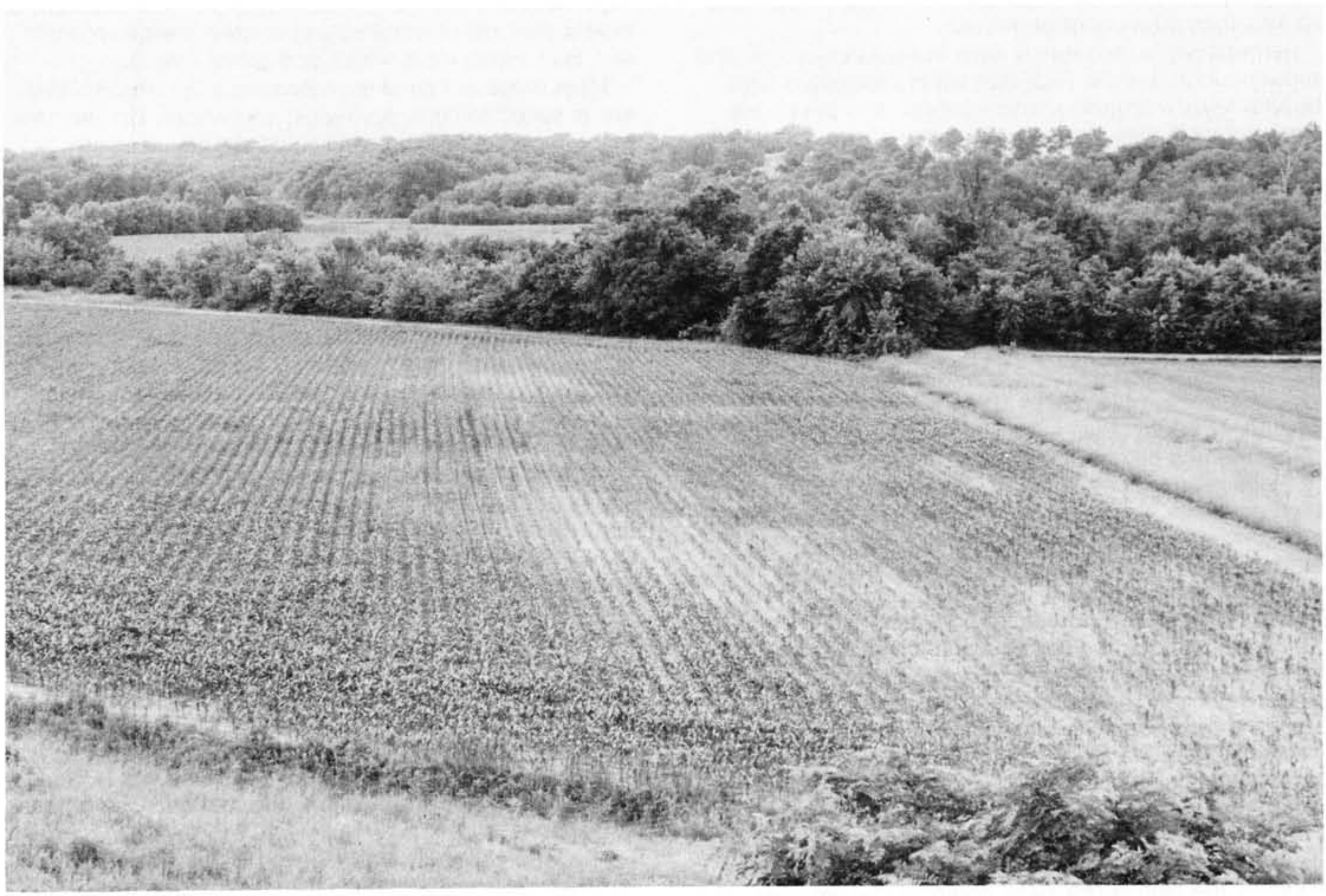

Figure 8.—Corn in an area of Moniteau silt loam, 0 to 3 percent slopes. The sparse plant population is the result of low pH and poor drainage.

Most areas are used for cultivated crops, hay, or pasture. This soil is suited to corn, soybeans, and wheat. During most years flooding is a minor problem for brief periods in late winter or early spring. When summer annual crops are planted and harvested, however, crop damage commonly is only minor.

This soil is well suited to reed canarygrass and moderately well suited to tall fescue, red clover, birdsfoot trefoil, and switchgrass. The flooding is the main problem. It should affect the selection of species for planting. A drainage system is beneficial, especially if deep-rooted species are grown. A seedbed can be easily prepared.

A few small areas support native hardwoods. This soil is suited to trees, including high-value species, such as black walnut and pecan. The hazard of spring flooding should be considered when planting and harvesting activities are scheduled. The forested areas should be protected from grazing and fire.

This soil generally is unsuitable for building site development and onsite waste disposal because of the flooding.

The land capability classification is IIw. The woodland ordination symbol is 9A.

53—Chequest silty clay loam. This deep, nearly level, poorly drained soil is in low drainageways and broad depressions on the flood plains along the major streams. It is protected by levees in some areas but is frequently flooded in unprotected areas. Individual areas are irregularly shaped and range from 50 to 300 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 9 inches thick. The subsurface layer is very dark gray, mottled, firm silty clay loam about 8 inches thick. The subsoil is dark gray, mottled, very firm silty clay loam about 43 inches thick. In places the surface layer is dark grayish brown silty clay loam.

Included with this soil in mapping are small areas of Piopolis soils. These soils are in the slightly higher areas adjacent to stream channels. They make up about 10 percent of the unit.

Permeability is moderately slow in the Chequest soil, and surface runoff is slow. Available water capacity is high. Natural fertility also is high, and organic matter content is moderate. The shrink-swell potential is high. A seasonal high water table is at a depth of 1 to 3 feet during winter and spring.

Most areas are used for cultivated crops. Some are used for hay and pasture. This soil is suited to corn, soybeans, and wheat. The wetness is the main limitation. Also, the flooding can damage crops during some years. A drainage system is needed. Field ditches can improve surface drainage if adequate outlets are available. Extremely wet areas also can be improved by land grading and shaping.

This soil is best suited to a mixture of pasture and hay plants that includes water-tolerant varieties. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the seasonal high water table. Proper stocking rates and deferment of grazing during wet periods help to keep the pasture in good condition.

This soil is suited to trees. Seedling mortality, the windthrow hazard, and the equipment limitation are management concerns. Planting container-grown nursery stock increases the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely. Equipment should be used only when the soil is dry or during winter, when the ground is frozen.

This soil generally is unsuitable for building site development and onsite waste disposal because of the flooding.

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

55—Piopolis silty clay loam. This deep, nearly level, poorly drained soil is on flood plains along the major streams. It is frequently flooded unless protected by levees. Individual areas are irregularly shaped and range from 50 to 400 acres in size.

Typically, the surface layer is dark grayish brown, firm silty clay loam about 10 inches thick. The substratum to a depth of 60 inches or more is dark gray, mottled, firm and very firm silty clay loam. It has thin strata of silty clay in the lower part. In some areas the surface layer is very dark grayish brown.

Included with this soil in mapping are small areas of Chequest soils. These soils are in broad areas on the slightly lower parts of the landscape. They make up less than 10 percent of the unit.

Permeability is slow in the Piopolis soil. Surface runoff also is slow. Available water capacity is very high. Natural fertility is medium, and organic matter content is moderately low. The shrink-swell potential is moderate. A seasonal high water table is 0.5 foot above the surface to 3.0 feet below during most winter and spring months.

Most areas are used for cultivated crops. Some are used for pasture or hay. This soil is suited to corn, soybeans, and wheat. The wetness is the main limitation. It can be reduced by a surface drainage system and by land leveling. Floodwater can damage crops during some years. Returning crop residue to the soil helps to maintain fertility and tilth.

This soil is best suited to water-tolerant, shallow-rooted pasture species. It is poorly suited to hay. The wetness and the flooding are the main problems. The hazard of flooding should be considered when a grazing system is designed. A surface drainage system is beneficial, especially if deep-rooted species are grown. A seedbed can be easily prepared unless the soil is wet.

Many low areas are wooded. Numerous pecan plantations are in areas of this soil. The soil is suited to trees. The equipment limitation, seedling mortality, and the windthrow hazard are concerns in planting and harvesting trees. Equipment should be used only when the soil is dry and firm or during winter, when the ground is frozen. Planting container-grown nursery stock increases the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil generally is unsuited to building site development and onsite waste disposal because of the flooding.

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

60E—Bethesda shaly silt loam, 9 to 20 percent slopes. This deep, strongly sloping and moderately steep, well drained soil is on mine spoils in areas that have been surface mined for coal. These areas have been leveled and shaped to some extent. The soil is a mixture of rock fragments and partly weathered fine-earth material that was in or below the profile of the original soil. Most of the rock fragments are less than 10 inches long and are limestone or shale. The fine earth is mainly glacial till that has been severely altered by mining equipment. Individual areas are irregular in shape and range from 20 to 150 acres in size.

Typically, the surface layer is grayish brown, friable shaly silt loam about 5 inches thick. The substratum to a depth of about 60 inches is mixed yellowish brown and brown, friable very shaly silty clay loam and clay loam. Some areas occur as a mixture of acid shale and coal. The acidity of these areas has a toxic effect on most plants. Grading and blanketing the surface with a layer of material removed from other soils have reclaimed a few of these "hot spots." In places the substratum is medium acid or slightly acid.

Permeability is moderately slow, and surface runoff is very rapid. Available water capacity is moderate. Natural fertility is low, and organic matter content is very low. The depth of the root zone varies within short distances because of differences in the density of the soil material.

Most areas are used for pasture or hay. Because of the slope and the low fertility and acidity of the root zone, this soil is unsuited to cultivated crops. It generally is poorly suited to pasture and hay. The only suitable forage species are those that can tolerate the very strongly acid and extremely acid, droughty, restricted root zone. If the pasture is overgrazed or is cultivated during seedbed preparation, the hazard of erosion is very severe. A good ground cover and surface mulch reduce the runoff rate and the susceptibility to erosion and increase the rate of water intake.

The only suitable tree species are those that can tolerate the acid root zone. Once established, such species as black locust, eastern cottonwood, and white pine grow well on this soil. Erosion can be controlled by building logging roads on the contour. The use of equipment is restricted during wet periods, when the soil is soft and slippery. The equipment should be used only when the soil is dry or during winter, when the ground is frozen.

This soil generally is unsuited to most kinds of building site development and sanitary facilities because of the slope and the unstable nature of the soil material.

The land capability classification is VIe. No woodland ordination symbol is assigned.

60F—Bethesda shaly silt loam, 20 to 70 percent slopes. This deep, steep and very steep, well drained soil occurs as areas of mine spoil on side slopes that have been surface mined for coal (fig. 9). The soil is a mixture of rock fragments and partly weathered fine-earth material that was in or below the profile of the original soil. Most of the rock fragments are less than 10 inches long and are limestone or shale. The fine earth is mainly glacial till that has been severely altered by mining equipment. Most areas have not been graded or smoothed. Slopes are generally rough and uneven. Hillside slippage occurs in some areas. Individual areas are irregular in shape and range from 100 to 1,000 acres in size.

Typically, the surface layer is grayish brown, friable shaly silt loam about 5 inches thick. The substratum to about 60 inches is brownish yellow, strong brown, and yellowish brown, firm very shaly clay loam. In some areas, known locally as "hot spots," the extreme acidity of the soil limits plant growth. In some places the substratum is extremely shaly clay loam. In other places it is medium acid or slightly acid.

Included with this soil in mapping are long and narrow, intermittent and perennial ponds in abandoned pits. Also included are small areas where the soil has many limestone boulders. Included areas make up about 15 percent of the unit.

Permeability is moderately slow in the Bethesda soil, and surface runoff is very rapid. Available water capacity is moderate. Unless the soil has been limed, the root zone is strongly acid to extremely acid. Natural fertility is low, and organic matter content is very low. The depth of the root zone varies within short distances because of differences in the density of the soil material.

Most areas support poor-quality timber and shrubs. Some are bare or are only sparsely covered with broomsedge and other acid-tolerant plants. Because of the slope, droughtiness, and a very severe hazard of erosion, this soil is generally unsuited to row crops and to hay and pasture. Selected grasses and legumes can be grown for pasture, but some leveling and land shaping is needed.

Black locust, eastern cottonwood, and white pine are established in many areas. This soil is suited to tree species that can withstand the acid, droughty, restricted root zone. Erosion is a hazard. It can be minimized by building logging roads on the contour. The use of equipment is restricted because the soil is steep and very steep and is soft and slippery when wet. Hand planting of seedlings may be needed.

The water-filled pits can be developed as habitat for wetland wildlife. Commonly, the supplies of water and food are adequate for many species of fish. The spoil areas around the pits support plants that provide food and cover for openland wildlife.

This soil generally is unsuited to building site development and sanitary facilities because of the slope and the unstable nature of the soil material.

The land capability classification is VIIe. No woodland ordination symbol is assigned.

62C—Schuline silty clay loam, 3 to 9 percent slopes. This deep, gently sloping and moderately sloping, well drained soil is on ridgetops and side slopes in the uplands. It is in areas that were surface mined for coal and then were graded and reclaimed (fig. 10). Individual areas generally are rectangular and range from 20 to 100 acres in size.

Typically, the surface layer is mixed dark brown and yellowish brown, very firm silty clay loam about 10 inches thick. The upper part of the substratum is mixed dark yellowish brown and yellowish brown, very firm clay loam. The lower part to a depth of about 60 inches is mixed grayish brown, dark grayish brown, and yellowish brown, firm silty clay loam. In places the substratum is shaly clay loam.

Permeability is slow, and surface runoff is medium. Available water capacity is high. Natural fertility and organic matter content are low. The shrink-swell potential is moderate. The compactness of the

Figure 9.—A typical area of Bethesda shaly silt loam, 20 to 70 percent slopes.

substratum may limit the rooting depth for some forage species.

Most areas are used for pasture or hay. This soil is suited to corn, soybeans, and wheat. If cultivated crops are grown, erosion is a hazard. It can be controlled by a system of conservation tillage that leaves protective amounts of crop residue on the surface, winter cover crops, a combination of terraces and grassed waterways, contour farming, stripcropping, and a conservation cropping system that includes grasses and legumes for pasture and hay. Some type of grade-stabilization structure generally is needed in areas where grassed waterways are established. Returning crop residue to the soil or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration.

This soil is well suited to alfalfa, sweetclover, tall fescue, orchardgrass, big bluestem, and indiangrass. The best suited forage species are those that can tolerate the limited rooting depth. Erosion during seedbed preparation is the major management concern. Timely tillage and a quickly established ground cover help to prevent excessive soil loss.

A few small areas, especially those on the steeper slopes, are planted to hardwoods. This soil is suited to trees.

This soil is suitable for building site development, but the slope and the moderate shrink-swell potential are limitations. Some land shaping generally is necessary to

Figure 10.—A reclaimed area of Shuline silty clay loam, 3 to 9 percent slopes. Keswick silt loam, 9 to 20 percent slopes, eroded, is in the wooded area in the background.

modify the slope. The structural damage caused by shrinking and swelling can be minimized by using adequately reinforced concrete in properly designed footings, foundations, and basement walls, by providing additional reinforcement steel and expansion joints, and by backfilling with sand or gravel. Installing tile drains around footings helps to prevent the damage caused by excessive wetness.

Because of the slow permeability, this soil generally is unsuitable as a site for septic tank absorption fields. Sewage lagoons can function adequately if the site is leveled.

The land capability classification is IIIe. No woodland ordination symbol is assigned.

62D—Schuline silty clay loam, 9 to 14 percent slopes. This deep, strongly sloping, well drained soil is on side slopes in the uplands. It is in areas that were surface mined for coal and then were graded and reclaimed. Individual areas generally are rectangular and range from 50 to 200 acres in size.

Typically, the surface layer is mixed dark grayish brown, yellowish brown, and strong brown, firm silty clay loam about 11 inches thick. The upper part of the substratum is mixed dark grayish brown, strong brown, and yellowish brown, very firm clay loam. The lower part to a depth of about 60 inches is mixed dark grayish brown, strong brown, and yellowish brown shaly clay loam.

Permeability is slow, and surface runoff is medium. Available water capacity is high. Natural fertility and organic matter content are low. The shrink-swell potential is moderate. The compactness of the substratum may limit the rooting depth for some forage species.

Most areas are used for pasture or hay. This soil is suitable for occasional cultivation if erosion is carefully controlled. A system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, stripcropping, and grassed waterways help to prevent excessive soil loss. Uniform slopes can be terraced and farmed on the contour. Returning crop residue to the soil and planting green manure crops help to control erosion, maintain or improve tilth and the organic matter content, and increase the rate of water infiltration.

This soil is well suited to alfalfa, sweetclover, tall fescue, orchardgrass, big bluestem, and indiangrass. The best suited forage species are those that can tolerate the limited rooting depth. Erosion during seedbed preparation is the major management concern. Overgrazing or grazing when the soil is wet results in surface compaction, poor tilth, and excessive runoff. Proper stocking rates, rotation grazing, and deferment of grazing during wet periods help to keep the pasture in good condition.

A few small areas, especially those on the steeper slopes, are planted to hardwoods. This soil is suited to trees.

This soil is suitable for building site development, but the slope and the moderate shrink-swell potential are limitations. Some land shaping generally is necessary to modify the slope. The structural damage caused by shrinking and swelling can be minimized by using adequately reinforced concrete in properly designed footings, foundations, and basement walls, by providing additional reinforcement steel and expansion joints, and by backfilling with sand or gravel. Installing tile drains around footings helps to prevent the damage caused by excessive wetness.

Because of the slow permeability, this soil generally is unsuitable as a site for septic tank absorption fields. Sewage lagoons can function adequately if the site is leveled.

The land capability classification is IIIe. No woodland ordination symbol is assigned.

64—Udorthents-Pits complex. This map unit is in areas where limestone has been quarried. Slopes range from 15 to 60 percent. Individual areas range from 20 to 150 acres in size. They are about 65 percent Udorthents and 25 percent Pits.

The Udorthents are soils that formed in overburden of loess and glacial till mixed with varying amounts of rock fragments. Typically, the surface layer is mixed brown and yellowish brown, firm very gravelly silty clay loam about 9 inches thick. The upper part of the substratum is mixed dark yellowish brown, brownish yellow, and light yellowish brown, firm channery silty clay loam. The next part is mixed yellowish brown, light olive brown, dark gray, and grayish brown, firm silty clay loam. The lower part to a depth of 60 inches or more is mixed dark yellowish brown and yellowish brown, firm very channery silty clay loam.

The Pits are deep excavations from which overburden and limestone have been removed. They generally do not support plants. They are 10 to about 100 feet deep and typically have nearly vertical sides. Small areas of water are common in some of the pits.

Included in this unit in mapping are some areas that have been reshaped and then seeded to grasses and legumes for pasture and hay. These areas make up about 10 percent of the unit.

Permeability varies widely in the Udorthents, but in most areas it is estimated to be moderately slow. Surface runoff is rapid. Available water capacity is moderate. In most areas reaction is moderately alkaline. Natural fertility and organic matter content are very low.

This map unit generally is not suited to any kind of cultivation, building site development, or onsite waste disposal because of the slope and the many stones and boulders on the surface. Most areas of the Udorthents are idle and are reverting to eastern cottonwood, American sycamore, and willow. These areas can be used as habitat for wildlife.

No land capability classification or woodland ordination symbol is assigned.

Prime Farmland

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

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

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

About 124,460 acres in the county, or nearly 40 percent of the total acreage, is prime farmland. Of this acreage, approximately 85,000 acres is cropland. Scattered areas of prime farmland are throughout the county, mainly in associations 1, 4, and 5, which are described under the heading "General Soil Map Units."

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

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

Some soils that have a seasonal high water table and all soils that are frequently flooded during the growing season qualify for prime farmland only in areas where these limitations have been overcome by drainage measures or flood control. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not these limitations have been overcome by corrective measures. Most areas of the naturally wet soils in the county are adequately drained because of the application of drainage measures or the incidental drainage that results from farming, road building, or other kinds of land development.

Use and Management of the Soils

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

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

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

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

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

Michael J. Bradley, district conservationist, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

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

Approximately 228,275 acres in the county, or 73 percent of the total acreage, was used for crops and pasture in 1970. Of this total, about 98,275 acres was used for permanent pasture and 130,000 acres for cultivated crops, mainly soybeans, corn, wheat, and grain sorghum.

Loss of cropland to highway construction and urban development has been slight in the county. A small acreage of cropland has been temporarily lost to surface mining. The productivity of this cropland is restored through the strict reclamation procedures required by state and federal regulations. Before an area is mined for coal, information about the soils in the area is obtained and used to ensure that the reclaimed soils will be as productive as they were in their original condition.

The potential of the soils in Randolph County for sustained production of food is good. About 124,460 acres in the county is prime farmland. Only about 30 percent of the cropland and 74 percent of the pasture in the county, however, are adequately treated for conservation. Cropland that is not adequately treated is likely to be in areas on uplands where water erosion is in excess of what is considered tolerable for sustained production. Marginal land used for row crops should be converted to grassland, or adequate conservation systems should be applied.

Water erosion is the major problem on nearly all of the sloping cropland and overgrazed pasture in the county. All soils that have a slope of more than 2 percent are susceptible to erosion. As all or part of the surface layer is lost through erosion and part of the subsoil is incorporated into the plow layer, productivity is reduced. Loss of the surface layer is especially damaging to soils that have a clayey subsoil. Erosion also reduces the productivity of soils that tend to be droughty because they are shallow or moderately deep to bedrock. Examples are Norris Variant and Gosport soils.

Erosion on farmland results in sedimentation of streams, lakes, and ponds. Controlling erosion minimizes this pollution and improves the quality of water for municipal use, for recreation, and for fish and wildlife. It also prolongs the useful life of the ponds and lakes by preventing sedimentation.

Many fields have clayey spots where seedbed preparation and tillage are difficult because the original friable surface soil has been eroded away. These eroded spots occur in areas of Calwoods, Gorin, Keswick, Lagonda, and Leonard soils.

Erosion on most of the cropland can be held within tolerable limits by conservation measures designed for specific sites and situations. These measures can protect the surface of the soil, reduce the runoff rate, and increase the rate of water infiltration. A cropping system that keeps a plant cover on the soil for extended periods reduces the hazard of erosion and preserves the productive capacity of the soil. Growing grasses and legumes for pasture and hay is effective in controlling erosion. Including legumes, such as clover and alfalfa, in the cropping sequence improves tilth and provides nitrogen for the following crop.

Terraces shorten the length of slopes and thus reduce the runoff rate and the hazard of erosion. Special construction and management techniques are necessary if terraces are to be effective in most moderately sloping areas of the eroded Keswick and Lagonda soils and in gently sloping areas of Leonard soils. Terraces and a cropping system that provides a substantial vegetative cover are needed on these soils.

Systems of conservation tillage provide a protective cover and therefore reduce the runoff rate and increase the rate of water infiltration. These systems leave much of the crop residue on the surface.

Contour stripcropping helps to control erosion by maintaining a permanent cover of grasses and legumes in contoured strips. These strips are generally used for hay. Row crops are planted on the contour in the areas between the strips.

Soil drainage and flood control are management concerns on all of the soils on flood plains in Randolph County. Flooding can be a problem on Chequest, Piopolis, and Wilbur soils. It commonly occurs during the period October through June. Bremer and Moniteau soils are naturally so wet that crop production tends to be reduced. The nearly level Putnam soils, which are on the broad tops of ridges in the uplands, are very slowly permeable. When these soils receive excess water, they stay wet for long periods. Excess water can be removed from most of the soils by land grading and field ditches.

Few irrigation systems are currently used in Randolph County. Some areas are irrigated by a center-pivot or traveling-gun system. Irrigation systems increase yields by supplying supplemental water during critical periods of crop growth. They make double-cropping an attractive alternative. Soybeans can be planted directly into wheat stubble. The irrigation system supplies enough water to ensure the germination of seeds and crop growth. The large amount of crop residue on the surface in these double-cropped areas helps to control erosion.

Soil fertility is naturally lower in most eroded soils than in uneroded soils. Additions of plant nutrients can improve the productivity of all soils. Most of the soils in the county are naturally acid in the upper part of the root zone. Applications of ground limestone are needed to raise the pH and calcium levels sufficiently for optimum plant growth. On all soils additions of lime and fertilizer should be based on the results of soil tests, on the needs of the crop, and on the expected level of yields. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime to be applied.

Soil tilth is an important factor affecting the germination of seeds and the infiltration of water into the soil. Soils with good tilth are granular and porous. Most of the uneroded upland soils that are used for crops have a surface layer of silt loam or silty clay loam. Tillage and compaction generally weaken the structure of the silt loams, and a surface crust forms during periods of intensive rainfall. The crust is hard when dry. As a result, it reduces the rate of water infiltration and increases the runoff rate. Regularly adding crop residue, manure, and other organic material improves soil structure and tilth.

All of the eroded soils on uplands have more clay in the surface layer than is typical in uneroded soils. As a result, tilth is poorer, the rate of water infiltration is slower, and the runoff rate is more rapid. Measures that control erosion help to prevent further deterioration of tilth in the eroded soils.

Fall plowing is common in Randolph County, but it generally is not a good means of improving the tilth of the soils on uplands. These soils generally are sloping and are subject to erosion if they are plowed in the fall.

The dominant field crops in Randolph County are corn and soybeans. In 1983, soybeans were grown on about 47,700 acres and corn was grown on 11,700 acres. Grain sorghum was grown on about 3,200 acres. Wheat, the dominant close-growing crop, was grown on about 15,400 acres.

The pasture plants and hay crops that are suited to the soils and climate in Randolph County include several legumes, cool-season grasses, and warm-season native grasses. Alfalfa and red clover are the most common legumes grown for hay. They also are seeded in mixtures that include bromegrass or orchardgrass. Birdsfoot trefoil can be seeded alone or in mixtures that include bromegrass, orchardgrass, tall fescue, or bluegrass. The suitable warm-season grasses include big bluestem, indiangrass, and switchgrass. These grasses grow well during the summer, when the cool-season species are dormant. The management needed for warm-season grasses differs from that needed for cool-season grasses.

Deep, well drained soils, such as Lindley and Schuline, are well suited to alfalfa. Other legumes and most of the grasses generally grow well on the soils in the uplands. Chequest and Piopolis soils are frequently flooded and stay wet for long periods. They are better suited to short-season summer annuals or water-tolerant species, such as reed canarygrass, than to other forage species.

The major concerns in managing pasture are overgrazing and erosion. Controlled grazing helps to maintain maximum forage production. Keeping the grasses at a desirable height reduces the runoff rate and helps to control erosion.

The specialty crops grown in the county include apples, peaches, pecans, Christmas trees, and various garden vegetables. The latest information about growing these crops can be obtained from local offices of the Cooperative Extention Service and the Soil Conservation Service.

Yields Per Acre

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

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

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

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

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

Land Capability Classification

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

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit *(12)*. Only class and subclass are used in this survey.

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

Class I soils have few limitations that restrict their use.

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

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

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

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

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

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

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

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

The capability classification of nearly every map unit, except for the Udorthents-Pits complex, is given in the section "Detailed Soil Map Units" and in the yields table.

Woodland Management and Productivity

James L. Robinson, forester, Soil Conservation Service, helped prepare this section.

Approximately 17 percent of the acreage in Randolph County is forest. The species and growth rates of the trees in the wooded areas vary, depending on site conditions and the kinds of soil. Soils serve as a reservoir for moisture, provide an anchor for tree roots, and supply most of the available plant nutrients. The soil properties that directly or indirectly affect tree growth include reaction, natural fertility, drainage, texture, structure, and depth.

Many of the soils on uplands, such as Keswick soils, formed in glacial till and have a subsoil that is high in content of clay. The high content of clay restricts the amount of water available to plants and thus reduces the production potential of the site. The available water capacity is influenced primarily by texture, rooting depth, and content of stones.

Site characteristics that affect tree growth include aspect and position on the landscape. They affect the amount of available sunlight, air drainage, soil temperature, and moisture relationships. Generally, north and east aspects are cooler and have more moisture than south and west aspects. Low areas can collect additional water and thus commonly are the best upland sites for tree growth.

About 25 percent of the woodland in the county is grazed. Grazing destroys the layer of leaves on the surface, which is important in erosion control and in the nutrient cycle. Grazing also results in compaction, which decreases the rate of water infiltration. Many areas where grazing pressure is significant support the lower quality species that can withstand this abuse. The extent of post oak, black oak, elm, hawthorn, locust, and hickories increases under this pressure.

The soils in the Mexico-Leonard-Putnam soil association, which is described under the heading "General Soil Map Units," formed mainly under prairie vegetation. The Lagonda soils in the Keswick-Lagonda association also formed under prairie vegetation. The Leonard and Keswick soils on side slopes formed under forest cover. Some areas of these soils still support timber. The dominant tree species are white oak, black oak, post oak, and hickories. Other species include pin oak and black walnut.

A significant acreage of the Keswick-Lindley-Gorin and Gosport-Gorin associations support the oak-hickory forest cover. The typical species are white oak, northern red oak, black oak, hickories, post oak, ash, black cherry, and black walnut. Species composition and growth rates vary. Vigorous stands of almost pure white oak are common on the north- and east-facing slopes. Lower quality, more slowly growing species generally are on the south-facing slopes. If properly managed, however, these sites can produce quality white oak.

The Piopolis-Chequest association supports bottomland hardwoods that can grow on poorly drained soils. The typical species on the Piopolis soils and on Moniteau soils, which are of minor extent in this association, are green ash, pin oak, swamp white oak, hackberry, and river birch. The Chequest soils support some cottonwood and silver maple. Other species in wooded areas of this association are sycamore, shellbark hickory, shingle oak, and some walnut. The walnut species grow on the better drained soils. This association is highly productive and responds very well to good management.

The Bethesda-Schuline association is in areas that have been surface mined for coal. The Bethesda soils formed in acid material mixed by mining activities conducted before the enactment of the Surface Mining Control and Reclamation Act of 1977. The forest cover on the Bethesda soils is a result of successful forest plantings or natural invasion. The most common species are black locust, eastern cottonwood, pin oak, shingle oak, hackberry, black cherry, and American elm. The forest cover protects the surface against erosion, provides food and cover for wildlife, enhances recreational areas, or is cut for firewood.

The Schuline soils were reclaimed after 1977. They probably can support any of the original native tree species, but they have not been reclaimed long enough for an evaluation of species composition.

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

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

In table 7, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

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

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

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

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

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

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

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

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

Windbreaks and Environmental Plantings

James L. Robinson, forester, Soil Conservation Service, helped prepare this section.

Well designed farmstead, feedlot, and field windbreaks are needed throughout Randolph County. They are especially needed in the prairie areas of the Mexico-Leonard-Putnam and Keswick-Lagonda associations, which are described under the heading "General Soil Map Units." Windbreaks can significantly reduce the amount of energy required to heat a home and can moderate the effects of cold winter winds. Animals protected by a windbreak are healthier than those not protected against the winter winds. Also, crop production is increased in areas protected by field windbreaks.

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

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

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

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service, the Missouri Department of Conservation, or the Cooperative Extension Service or from a commercial nursery.

Recreation

Edward A Gaskins, biologist, Soil Conservation Service, helped prepare this section.

In 1980, a total of 5,672 acres in Randolph County was used for recreational purposes *(10)*. Ownership of this acreage is about 61 percent state, 21 percent municipal, and 18 percent private. The facilities include lakes, pools, golf courses, game courts, picnic areas, campgrounds, and hunting areas. The demand for recreational facilities is likely to increase somewhat because of a projected 10 percent increase in the population of the county by 1990 *(6)*.

The Thomas Hill Reservoir is the largest public recreational area in the county. This area offers opportunities for fishing, boating, camping, hiking, and hunting. Other major recreational areas are Rudolf Bennitt Wildlife Area, Rothwell Park, and Sugar Creek Lake.

The county has 10 private and semiprivate commercial recreation enterprises *(8)*. These include campgrounds, golf courses, a fishing lake, an outdoor theater, a skating rink, and a shooting preserve. The priority recreational needs in the county are for additional hiking trails and picnic areas.

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

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

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

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

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

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

Wildlife Habitat

Edward A. Gaskins, biologist, Soil Conservation Service, helped prepare this section.

Randolph County is one of 21 counties in Missouri that make up the Northeast Riverbreaks Zoogeographic Region *(7)*. Because of the diversity of different cover types, this region is one of the richest game areas in the state. As the transition zone between the prairie and the Ozark Border, the region provides a variety and abundance of plants and thus provides excellent wildlife habitat. The problems affecting the wildlife resource are surface mining, the conversion of woodland to grassland and cropland, and an increase in the size of fields, which results in the loss of hedgerows and brushy waterways. Fall plowing decreases the amount of food available to wildlife.

The Mexico-Leonard-Putnam, Keswick-Lindley-Gorin, Keswick-Lagonda, and Piopolis-Chequest soil associations, which are described under the heading "General Soil Map Units," provide most of the openland wildlife habitat in the county. The Gosport-Gorin and Bethesda-Schuline associations, however, also have large acreages of hayland and grassland. Scattered small blocks of timber, waterways, hedgerows, fence rows, and other areas providing woody or brushy cover commonly are throughout these associations.

Bobwhite quail is one of the most popular game species in the county. The population of this species is low, however, in all areas, except for the best habitat areas. The rabbit population is good, but hunter interest in this species is only fair. The resident dove population is poor, and fall migratory flights of this bird are minimal. A few sightings of ring-necked pheasant are reported annually, but the population of this species is too small for hunting. The population of songbirds is good to excellent throughout the county.

The furbearer population is good. Trapping pressure has declined somewhat because of a decrease in the price of furs. Harvest records show that raccoon, muskrat, opossum, coyote, red fox, beaver, mink, and gray fox are the principal species trapped. The once rare bald eagle is beginning to return to the county.

The Gosport-Gorin and Bethesda-Schuline associations provide most of the woodland wildlife habitat in the county. Approximately 28 percent of the county provides some form of woodland habitat, which includes areas of the smaller brushy plants.

The county has a good deer population. The carrying capacity for this animal has been reached. Interest in deer hunting is very high in the county. The turkey population currently is fair, but it is increasing as this species expands its range. Hunter interest in this game bird is high. The squirrel population is good, but this species is subject to only light hunting pressure. Woodcocks are scarce, and hunter interest is low because of the limited migratory flights of this game species.

Nearly all of the wetland habitat in the county is in areas of the Piopolis-Chequest association, which is on bottom land. Along with the Thomas Hill Reservoir, this association provides the primary habitat for waterfowl in the county. The reservoir acts as a concentration point for Canada, snow, and blue geese and for mallard, pintail, scaup, and teal. The population of wood ducks is low because riparian timber has been removed from many of the areas along streams.

Opportunities for fishing are available on rivers, streams, lakes, and farm ponds. Fishing pressure generally is light on the streams. The county has only 3 miles of permanently flowing streams *(6)*. The most important streams are the East and Middle Forks of the Chariton River. Anglers fish for channel catfish, carp, drum, bullheads, and sunfish.

The primary opportunities for impoundment fishing in the county are provided by the Thomas Hill Reservoir, Sugar Creek Lake, Rothwell Park Lake, Waterworks Lake, and Higbee City Reservoir. The Thomas Hill Reservoir is by far the largest impoundment. It includes 2,185 surface acres in Randolph County and 2,315 acres in Macon County. These lakes are fished for largemouth bass, channel catfish, crappie, bluegill, carp, and flathead catfish. The county has approximately 600 farm ponds and small lakes, which are stocked with largemouth bass, channel catfish, and bluegill.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

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

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

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

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

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, pokeweed, foxtail, croton, and partridge pea.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, cherry, hawthorn, hickory, blackberry, sassafras, wild plum, sumac, persimmon, Osageorange, and eastern redcedar. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are autumn olive, crabapple, Amur honeysuckle, hawthorn, and hazelnut.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, cutgrass, cattail, rushes, sedges, and buttonbush.

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

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

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

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

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

Engineering

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

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

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

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

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

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

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

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

Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

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

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

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 12 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

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

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

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

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

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

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

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

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

Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

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

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

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

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

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

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

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

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

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

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

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

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

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

Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome;

moderate if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

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

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

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

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

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

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

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock. The performance of a system is affected by the depth of the root zone and soil reaction.

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

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

Soil Properties

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

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

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

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

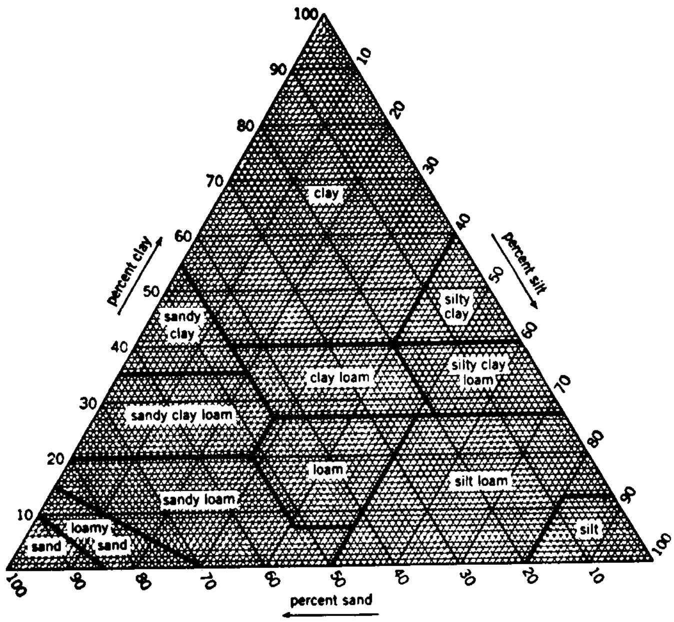

Figure 11.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 11). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system *(2)* and the system adopted by the American Association of State Highway and Transportation Officials *(1)*.

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

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

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

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

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

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

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

Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

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

Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

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

The four hydrologic soil groups are:

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

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

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

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

If a soil is assigned to two hydrologic groups in table 17, the first letter is for drained areas and the second is for undrained areas.

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

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

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

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

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

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17.

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

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

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

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

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

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

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

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(13)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

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

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

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

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

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

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

Soil Series and Their Morphology

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

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual (11)*. Many of the technical terms used in the descriptions are defined in *Soil Taxonomy (13)*. Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Bethesda Series

The Bethesda series consists of deep, well drained, moderately slowly permeable soils in upland areas that have been mined for coal. These soils formed in acid material mixed by surface mining activities. Slopes range from 9 to 70 percent.

Typical pedon of Bethesda shaly silt loam, 20 to 70 percent slopes, in an area of timber and shrubs; 500 feet east and 600 feet north of the southwest corner of sec. 14, T. 54 N., R. 15 W.

A—0 to 5 inches; grayish brown (10YR 5/2) shaly silt loam, light gray (10YR 7/2) dry; weak fine granular structure; friable; many medium roots; common fine prominent yellowish brown (10YR 5/6) stains; about 10 percent shale fragments and 10 percent coal fragments; extremely acid; abrupt wavy boundary.

C1—5 to 29 inches; mixed brownish yellow (10YR 6/8) and strong brown (7.5YR 5/6) very shaly clay loam; massive; friable; common medium roots; few brown (7.5YR 4/2) silt coatings on faces of coarse fragments; about 30 percent siltstone fragments and 20 percent weathered shale fragments; extremely acid; clear smooth boundary.

C2—29 to 45 inches; mixed yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) very shaly clay loam; massive; firm; few fine roots in the upper part; about 60 percent weathered shale fragments; extremely acid; clear wavy boundary.

C3—45 to 60 inches; mixed strong brown (7.5YR 5/6), brown (7.5YR 4/4), and yellowish brown (10YR 5/6) very shaly clay loam; massive; firm; about 30 percent siltstone fragments, 20 percent weathered shale fragments, and 10 percent sandstone fragments; extremely acid.

The depth to bedrock is more than 5 feet. The A horizon has hue of 10YR or 2.5Y and value of 4 to 6. The C horizon has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 2 to 8. It is very shaly silty clay loam or very shaly clay loam. The content of coarse fragments in this horizon ranges from 35 to about 60 percent.

Bremer Series

The Bremer series consists of deep, poorly drained, moderately slowly permeable soils on low stream terraces. These soils formed in silty alluvium. Slopes are 0 to 1 percent.

Typical pedon of Bremer silt loam, 2,100 feet east and 170 feet north of the southwest corner of sec. 34, T. 53 N., R. 15 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; common fine roots; slightly acid; clear smooth boundary.

A1—8 to 14 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; friable; common fine roots; slightly acid; clear smooth boundary.

A2—14 to 18 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; few fine prominent yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; firm; few fine roots; slightly acid; clear smooth boundary.

Btg1—18 to 32 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; common fine prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; slightly acid; clear smooth boundary.

Btg2—32 to 46 inches; gray (10YR 5/1) silty clay; few fine distinct brown (10YR 5/3) and common fine prominent dark yellowish brown (10YR 4/6) mottles; weak fine subangular blocky structure; very firm; few very fine roots; few faint clay films on faces of peds; common fine soft black oxides; slightly acid; clear smooth boundary.

Cg—46 to 60 inches; gray (10YR 5/1) silty clay loam; common medium prominent dark yellowish brown (10YR 4/6) and yellowish brown (10YR 5/6) mottles; massive; very firm; common fine concretions of iron and manganese oxide; slightly acid.

The solum is 40 to 60 inches thick. The mollic epipedon is 30 to 36 inches thick. The A horizon is 16 to 20 inches thick. The lower part of the B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. The C horizon has colors similar to those in the lower part of the B horizon.

Calwoods Series

The Calwoods series consists of deep, somewhat poorly drained, very slowly permeable soils on uplands. These soils formed in a thin mantle of loess and in the underlying pedisediment or glacial till. Slopes range from 2 to 5 percent.

Typical pedon of Calwoods silt loam, 2 to 5 percent slopes, eroded, 2,400 feet east and 250 feet south of the northwest corner of sec. 8, T. 52 N., R. 13 W.

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; very friable; common fine roots; neutral; abrupt smooth boundary.

BE—5 to 10 inches; brown (10YR 5/3) silty clay loam; common fine distinct dark brown (7.5YR 4/4) mottles; moderate medium granular structure; friable; common fine roots; common fine concretions of iron and manganese oxide; common fine dark brown (10YR 4/3) worm casts; strongly acid; clear smooth boundary.

Bt1—10 to 18 inches; dark grayish brown (10YR 4/2) silty clay; many medium prominent strong brown (7.5YR 4/6) mottles; moderate medium subangular blocky structure; very firm; common fine roots; many faint clay films on faces of peds; strongly acid; clear smooth boundary.

Bt2—18 to 34 inches; grayish brown (10YR 5/2) silty clay; many medium prominent yellowish red (5YR 4/6) and common medium prominent strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; very firm; few fine and very fine roots; common faint clay films on faces of peds; common fine black oxide stains; very strongly acid; clear smooth boundary.

BC—34 to 46 inches; grayish brown (10YR 5/2) silty clay loam; many coarse prominent strong brown (7.5YR 4/6) mottles; weak fine subangular blocky structure; firm; common fine black oxide stains; slightly acid; clear smooth boundary.

2C1—46 to 52 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium prominent strong brown (7.5YR 4/6 and 5/6) mottles; massive; firm; common fine black oxide stains; few clean fine sand grains; slightly acid; clear smooth boundary.

2C2—52 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium prominent dark yellowish brown (10YR 4/6) mottles; massive; friable; few clean sand grains; slightly acid.

The solum is 30 to 50 inches thick. The A horizon has value of 3 or 4 and chroma of 2 or 3. The Bt horizon has hue of 10YR or 2.5Y and chroma of 2 or 3. The 2C horizon has value of 5 or 6. Mottles with high chroma are throughout the Bt and 2C horizons.

Chequest Series

The Chequest series consists of deep, poorly drained, moderately slowly permeable soils on flood plains. These soils formed in silty and clayey alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Chequest silty clay loam, 500 feet east and 500 feet south of the northwest corner of sec. 6, T. 53 N., R. 15 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate medium granular structure; friable; common fine roots; neutral; clear smooth boundary.

A—9 to 17 inches; very dark gray (10YR 3/1) silty clay loam, grayish brown (10YR 5/2) dry; few fine distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; firm; common fine roots; medium acid; clear smooth boundary.

Bg1—17 to 43 inches; dark gray (10YR 4/1) silty clay loam; few fine distinct dark yellowish brown (10YR 3/4) mottles; moderate medium prismatic structure parting to moderate fine subangular blocky; very firm; few fine roots; medium acid; clear smooth boundary.

Bg2—43 to 60 inches; dark gray (10YR 4/1) silty clay loam; common medium prominent dark yellowish brown (10YR 4/6) mottles; moderate medium prismatic structure parting to moderate fine subangular blocky; very firm; few fine roots; medium acid; clear smooth boundary.

The solum is 40 to more than 60 inches thick. The mollic epipedon is 12 to 18 inches thick.

The Bg horizon has value of 4 or 5. It has mottles with higher chroma throughout. It is silty clay loam or silty clay. Some pedons have a Cg horizon, which is silty clay loam.

Gorin Series

The Gorin series consists of deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in a thin mantle of loess and in the underlying pedisediment. Slopes range from 5 to 9 percent.

Typical pedon of Gorin silt loam, 5 to 9 percent slopes, eroded, 850 feet west and 350 feet south of the northeast corner of sec. 16, T. 54 N., R. 13 W.

Ap—0 to 4 inches; dark grayish brown (10YR 4/2) silt loam, light gray (10YR 7/2) dry; weak fine granular structure; friable; common fine and medium roots; medium acid; clear smooth boundary.

BE—4 to 12 inches; yellowish brown (10YR 5/4) silty clay loam; weak fine subangular blocky structure; friable; common medium roots; few fine black oxide stains; very strongly acid; clear smooth boundary.

Bt1—12 to 19 inches; yellowish brown (10YR 5/4) silty clay; moderate fine subangular blocky structure; firm; common fine roots; few faint clay films on faces of peds; common light gray (10YR 7/2) silt coatings on faces of peds; very strongly acid; clear smooth boundary.

Bt2—19 to 27 inches; brown (10YR 5/3) silty clay; common fine faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few fine roots; common faint clay films on faces of peds; very strongly acid; clear smooth boundary.

2Bt3—27 to 48 inches; mixed brown (10YR 5/3) and yellowish brown (10YR 5/6) clay loam; few fine faint grayish brown (10YR 5/2) mottles; weak fine subangular blocky structure; firm; few very fine roots; few faint clay films on faces of peds; strongly acid; clear smooth boundary.

2Bt4—48 to 60 inches; brown (10YR 5/3) clay; moderate medium distinct yellowish brown (10YR 5/6) and moderate medium faint grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to moderate fine subangular blocky; very firm; few very fine roots; common distinct clay films on faces of peds; medium acid.

The solum is 48 to more than 60 inches thick. The A horizon has value of 3 or 4. The Bt horizon has hue of 10YR or 7.5YR and value of 4 or 5. The 2Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. Mottles with hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 to 6 are throughout the Bt and 2Bt horizons.

Gosport Series

The Gosport series consists of moderately deep, moderately well drained, very slowly permeable soils on uplands. These soils formed in material weathered from stratified Pennsylvanian shale. Slopes range from 14 to 30 percent.

Typical pedon of Gosport silt loam, 14 to 30 percent slopes, eroded, 200 feet east and 2,300 feet north of the southwest corner of sec. 15, T. 53 N., R. 14 W.

A—0 to 2 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; many fine and medium roots; few faint dark brown oxide stains; slightly acid; clear wavy boundary.

E—2 to 5 inches; brown (10YR 5/3) silt loam; moderate fine granular structure; friable; many fine roots; very strongly acid; clear wavy boundary.

Bw1—5 to 14 inches; yellowish brown (10YR 5/4) silty clay; common medium distinct yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; firm; common medium roots; very strongly acid; clear wavy boundary.

Bw2—14 to 28 inches; yellowish brown (10YR 5/4) silty clay; weak fine subangular blocky structure; firm; common fine roots; about 10 percent shale fragments; very strongly acid; clear smooth boundary.

Bw3—28 to 36 inches; light olive brown (2.5Y 5/4) silty clay; weak thin platy structure breaking to weak fine subangular blocky; firm; few very fine roots; about 15 percent shale fragments; very strongly acid; clear smooth boundary.

Cr—36 to 60 inches; light olive brown (2.5Y 5/4), gray (5Y 6/1), and strong brown (7.5YR 4/6), soft clayey shale; moderate medium platy rock structure; extremely firm; medium acid.

The solum is 20 to 40 inches thick. The A horizon has value of 3 or 4 and chroma of 1 or 2. The Bw horizon has value of 5 or 6 and chroma of 3 or 4. The Cr horizon has hue of 7.5YR to 5Y or is neutral in hue. It has value of 4 to 6 and chroma of 0 to 6.

Grundy Series

The Grundy series consists of deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in loess. Slopes range from 2 to 5 percent.

Typical pedon of Grundy silt loam, 2 to 5 percent slopes, 2,400 feet west and 1,000 feet south of the northeast corner of sec. 15, T. 54 N., R. 15 W.

Ap—0 to 10 inches; very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; very friable; common fine roots; medium acid; clear smooth boundary.

A—10 to 16 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate medium granular structure; friable; common fine roots; medium acid; clear smooth boundary.

Bt1—16 to 21 inches; dark grayish brown (10YR 4/2) silty clay; many coarse distinct yellowish brown (10YR 5/4) mottles; weak fine subangular blocky structure; firm; few fine roots; few distinct clay films on faces of peds; strongly acid; clear smooth boundary.

Bt2—21 to 36 inches; mixed dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) silty clay; common medium prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; few distinct clay films in vertical pores and root channels; medium acid; clear smooth boundary.

Bt3—36 to 50 inches; dark grayish brown (10YR 4/2) silty clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few very fine roots; few faint clay films on faces of peds and in vertical pores and root channels; common fine concretions of iron and manganese oxide; slightly acid; clear smooth boundary.

Bt4—50 to 56 inches; grayish brown (10YR 5/2) silty clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few very fine roots; few faint clay films on faces of peds and in vertical pores and root channels; common fine concretions of iron and manganese oxide; slightly acid; clear smooth boundary.

2C—56 to 60 inches; light olive gray (5Y 6/2) clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; slightly acid.

The solum is 48 to 60 inches thick. The mollic epipedon is 11 to 16 inches thick.

The A horizon has chroma of 1 or 2. The Bt horizon has hue of 10YR or 2.5Y. It is silty clay loam or silty clay. The 2C horizon has hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 1 or 2. It is silty clay loam or clay loam.

Keswick Series

The Keswick series consists of deep, moderately well drained, slowly permeable soils on uplands. These soils formed in glacial till. Slopes range from 5 to 20 percent.

Typical pedon of Keswick silt loam, 9 to 20 percent slopes, eroded, 1,000 feet west and 950 feet north of the southeast corner of sec. 9, T. 54 N., R. 15 W.

Ap—0 to 5 inches; dark brown (10YR 3/3) silt loam, brown (10YR 4/3) dry; moderate fine granular structure; friable; common fine roots; strongly acid; abrupt smooth boundary.

2Bt1—5 to 11 inches; brown (7.5YR 4/4) clay; few fine prominent yellowish red (5YR 4/6) mottles; weak fine subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; very strongly acid; clear smooth boundary.

2Bt2—11 to 20 inches; brown (10YR 5/3) clay loam; few fine prominent red (2.5YR 4/8) and common medium faint light brownish gray (10YR 6/2) mottles; moderate fine subangular blocky structure; very firm; few very fine roots; few faint clay films on faces of peds; very strongly acid; clear smooth boundary.

2Bt3—20 to 37 inches; brown (10YR 5/3) clay loam; many fine prominent strong brown (7.5YR 4/6) and common fine faint light brownish gray (10YR 6/2) mottles; moderate fine subangular blocky structure; very firm; few very fine roots; few faint clay films on faces of peds; very strongly acid; clear smooth boundary.

2Bt4—37 to 60 inches; brown (7.5YR 4/4) clay loam; common fine prominent grayish brown (10YR 5/2) mottles; moderate fine subangular blocky structure; very firm; few faint clay films on faces of peds; medium acid.

The solum is 42 to more than 60 inches thick. The A horizon has value of 3 or 4 and chroma of 2 or 3. The 2Bt horizon has value of 4 to 6 and chroma of 2 to 6. The upper part of this horizon has mottles with hue of 2.5YR or 5YR. Some pedons have a 2C horizon. This horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 1 to 6. It is clay or clay loam.

Lagonda Series

The Lagonda series consists of deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in a thin mantle of loess and in the underlying pedisediment. Slopes range from 5 to 9 percent.

The Lagonda soils in this county have a thinner dark surface layer than is definitive for the series. This difference, however, does not significantly affect the use and management of the soils.

Typical pedon of Lagonda silt loam, 5 to 9 percent slopes, eroded, 2,600 feet east and 1,600 feet south of the northwest corner of sec. 15, T. 54 N., R. 15 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak thin platy structure breaking to moderate fine granular; friable; common fine roots; medium acid; clear smooth boundary.

BA—8 to 11 inches; dark grayish brown (2.5Y 4/2) silty clay loam; few medium prominent brown (7.5YR 5/4) mottles; weak fine subangular blocky structure; friable; common fine roots; medium acid; clear smooth boundary.

Bt1—11 to 16 inches; dark grayish brown (2.5Y 4/2) silty clay; common medium prominent yellowish brown (10YR 5/4) and few fine prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; common fine black oxide stains; medium acid; clear smooth boundary.

Bt2—16 to 21 inches; dark grayish brown (2.5Y 4/2) silty clay; common medium prominent yellowish brown (10YR 5/8) and strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; many prominent clay films on faces of peds; common fine soft black oxides; medium acid; clear smooth boundary.

2Bt3—21 to 36 inches; mixed dark grayish brown (2.5Y 4/2) and grayish brown (2.5Y 5/2) silty clay loam; common medium prominent yellowish brown (10YR 5/6) and common fine prominent strong brown (7.5YR 4/6) mottles; moderate fine subangular blocky structure; firm; few very fine roots; many prominent clay films on faces of peds; few fine black oxide stains; common clean sand grains; neutral; gradual smooth boundary.

2Bt4—36 to 42 inches; grayish brown (2.5Y 5/2) clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; firm; few faint clay films on faces of peds and lining vertical pores; few fine black oxide stains; neutral; gradual smooth boundary.

2C—42 to 60 inches; grayish brown (10YR 5/2) clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; firm; few fine pebbles; neutral.

The solum is 40 to 60 inches thick. The A horizon has chroma of 1 or 2. The Bt horizon has hue of 10YR or 2.5Y. It is silty clay loam or silty clay. The 2Bt horizon has hue of 10YR or 2.5Y and chroma of 1 or 2. The 2C horizon has value of 4 or 5. It is clay loam or clay.

Leonard Series

The Leonard series consists of deep, poorly drained, slowly permeable soils on uplands. These soils formed in a thin mantle of loess and in the underlying pedisediment or glacial till. Slopes range from 2 to 6 percent.

Typical pedon of Leonard silt loam, 2 to 6 percent slopes, eroded, 200 feet east and 600 feet south of the northwest corner of sec. 10, T. 54 N., R. 13 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; many fine roots; neutral; abrupt smooth boundary.

BA—7 to 11 inches; dark grayish brown (10YR 4/2) silty clay loam; common fine prominent red (2.5YR 4/6) mottles; weak fine subangular blocky structure; friable; many fine roots; few faint clay films on faces of peds; medium acid; clear smooth boundary.

Btg1—11 to 17 inches; gray (10YR 5/1) silty clay; common medium prominent red (2.5YR 4/6) and few fine prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few distinct clay films on faces of peds; common fine roots; medium acid; clear smooth boundary.

Btg2—17 to 28 inches; gray (10YR 6/1) silty clay; many fine prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; very firm; few distinct clay films on faces of peds; few fine roots; strongly acid; clear smooth boundary.

2Btg3—28 to 42 inches; gray (10YR 6/1) silty clay; common fine prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; very firm; few fine roots; few distinct clay films on faces of peds; many fine dark brown oxide stains in root channels; few fine white chert fragments; common clean sand grains; slightly acid; abrupt smooth boundary.

2Btg4—42 to 60 inches; gray (10YR 5/1) silty clay; moderate medium prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; very firm; few faint clay films on faces of peds; common medium very dark grayish brown and yellowish red oxide stains; few fine white chert fragments; common clean sand grains; neutral.

The solum is more than 60 inches thick. The A horizon has chroma of 1 or 2. The Bt horizon is silty clay or silty clay loam. It has value of 4 or 5 in the upper part and value of 4 to 6 in the lower part. It has chroma of 1 or 2. It has mottles with hue of 2.5YR to 10YR, value of 4 or 5, and chroma of 6 throughout. The mottles with hue of 2.5YR or 5YR are most abundant in the upper part of this horizon.

Lindley Series

The Lindley series consists of deep, well drained, moderately slowly permeable soils on uplands. These soils formed in glacial till. Slopes range from 14 to 30 percent.

Typical pedon of Lindley loam, 14 to 30 percent slopes, 1,685 feet west and 400 feet north of the southeast corner of sec. 9, T. 54 N., R. 13 W.

A—0 to 4 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; many medium roots; slightly acid; abrupt smooth boundary.

E—4 to 8 inches; brown (10YR 5/3) loam; weak fine granular structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

Bt1—8 to 17 inches; yellowish brown (10YR 5/6) clay loam; weak fine subangular blocky structure; firm; common fine roots; few distinct clay films in vertical root channels; medium acid; clear smooth boundary.

Bt2—17 to 30 inches; yellowish brown (10YR 5/6) clay loam; moderate medium subangular blocky structure; firm; few fine roots; common faint clay films on faces of peds; medium acid; clear smooth boundary.

Bt3—30 to 49 inches; yellowish brown (10YR 5/6) loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; firm; few fine roots; few faint clay films in the larger pores; medium acid; gradual smooth boundary.

C—49 to 60 inches; yellowish brown (10YR 5/4) loam; common medium prominent strong brown (7.5YR 5/6) mottles; massive; firm; few fine roots; neutral.

The solum is 30 to 50 inches thick. The A horizon has value of 3 or 4. The Bt horizon has hue of 10YR or 7.5YR and chroma of 4 to 6. The C horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6.

Mexico Series

The Mexico series consists of deep, somewhat poorly drained, very slowly permeable soils on uplands. These soils formed in loess and in the underlying pedisediment. Slopes range from 1 to 4 percent.

Typical pedon of Mexico silt loam, 1 to 4 percent slopes, 1,000 feet west and 2,400 feet south of the northeast corner of sec. 34, T. 55 N., R. 13 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; common fine roots; medium acid; clear smooth boundary.

B/A—8 to 11 inches; dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) silty clay loam (Bt) and very dark grayish brown (10YR 3/2) silt loam (A); common medium prominent strong brown (7.5YR 5/6) and few fine prominent yellowish red (5YR 4/6) mottles; weak fine subangular blocky structure; friable; common fine roots; strongly acid; clear smooth boundary.

Bt1—11 to 19 inches; dark grayish brown (10YR 4/2) silty clay; many medium prominent red (2.5YR 4/6) and common medium prominent yellowish red (5YR 5/6) mottles; moderate fine subangular blocky structure; firm; few fine roots; common prominent clay films on faces of peds; very strongly acid; clear smooth boundary.

Bt2—19 to 24 inches; dark grayish brown (10YR 4/2) silty clay; many medium prominent strong brown (7.5YR 5/6) and common medium prominent red (2.5YR 4/6) mottles; moderate fine subangular blocky structure; very firm; few very fine roots; few distinct clay films on faces of peds and lining vertical pores; very strongly acid; clear smooth boundary.

Bt3—24 to 36 inches; grayish brown (10YR 5/2) silty clay; many medium prominent yellowish brown (10YR 5/6) and few medium prominent strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; very firm; few distinct clay films on faces of peds; strongly acid; clear smooth boundary.

2BC—36 to 53 inches; gray (10YR 5/1) silty clay loam; many medium prominent strong brown (7.5YR 5/6 and 4/6) mottles; weak fine subangular blocky structure; very firm; few clean sand grains; medium acid; gradual smooth boundary.

2C—53 to 60 inches; gray (10YR 5/1) silty clay loam; many medium prominent yellowish brown (10YR 5/6) and common medium prominent strong brown (7.5YR 4/6) mottles; massive; firm; few clean sand grains; medium acid.

The solum is 34 to more than 50 inches thick. The A horizon has chroma of 2 or 3. The Bt horizon has chroma of 1 or 2. It is silty clay or clay. The 2C horizon has value of 4 to 6 and chroma of 1 or 2. Mottles with hue of 2.5YR to 10YR, value of 3 to 5, and chroma of 4 to 6 are throughout the Bt and 2C horizons.

Moniteau Series

The Moniteau series consists of deep, poorly drained, moderately slowly permeable soils on low stream terraces. These soils formed in silty alluvium. Slopes range from 0 to 3 percent.

Typical pedon of Moniteau silt loam, 0 to 3 percent slopes, 2,600 feet west and 150 feet south of the northeast corner of sec. 25, T. 55 N., R. 13 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, light gray (10YR 7/2) dry; weak fine granular structure; friable; common fine dark yellowish brown oxide stains; many medium roots; slightly acid; abrupt smooth boundary.

E—7 to 15 inches; light brownish gray (10YR 6/2) silt loam; weak fine granular structure; friable; few fine roots; few fine concretions of iron and manganese oxide; strongly acid; abrupt smooth boundary.

Btg1—15 to 39 inches; grayish brown (10YR 5/2) silty clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure; friable; few fine roots; few faint clay films on faces of peds; few silt coatings; very strongly acid; clear smooth boundary.

Btg2—39 to 49 inches; light brownish gray (10YR 6/2) silty clay loam; common medium prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 4/6) mottles; weak fine subangular blocky structure; firm; few faint clay films on faces of peds; few silt coatings; very strongly acid; clear smooth boundary.

Cg—49 to 60 inches; light brownish gray (10YR 6/2) silty clay loam; many medium prominent yellowish brown (10YR 5/6) mottles; massive; firm; common medium black oxide stains; strongly acid.

The solum is 40 to more than 60 inches thick. The A horizon has chroma of 1 or 2. The E horizon has value of 5 or 6. The Btg and Cg horizons have value of 4 to 6 and chroma of 1 or 2 and have mottles with higher chroma.

Norris Variant

The Norris Variant consists of shallow, well drained, rapidly permeable soils on uplands. These soils formed in material weathered from stratified Pennsylvanian sandstone and shale. Slopes range from 14 to 35 percent.

Typical pedon of Norris Variant fine sandy loam, in an area of Norris Variant-Gosport complex, 14 to 35 percent slopes; 450 feet west and 1,750 feet south of the northeast corner of sec. 18, T. 53 N., R. 14 W.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; many fine roots; slightly acid; clear wavy boundary.

C—3 to 16 inches; yellowish brown (10YR 5/6) loamy fine sand; weak medium granular structure; very friable; common fine and medium and few coarse roots; medium acid; clear wavy boundary.

Cr1—16 to 32 inches; strong brown (7.5YR 4/6), soft, fractured sandstone that can be dug easily with a hand spade; massive; common medium roots in fractures; clear wavy boundary.

Cr2—32 to 60 inches; strong brown (7.5YR 5/6), soft, fractured sandstone that can be dug with some difficulty with a hand spade; massive.

The depth to sandstone bedrock is 8 to 20 inches. The A horizon has value of 3 or 4. It is dominantly fine sandy loam, but the range includes loam and silt loam. The C horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is loamy fine sand, loamy sand, fine sandy loam, sandy loam, or loam.

Piopolis Series

The Piopolis series consists of deep, poorly drained, slowly permeable soils on flood plains. These soils formed in silty alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Piopolis silty clay loam, 200 feet east and 750 feet north of the southwest corner of sec. 1, T. 53 N., R. 16 W.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) silty clay loam, light brownish gray (10YR 6/2) dry; moderate fine granular structure; firm; common fine roots; slightly acid; abrupt smooth boundary.

Cg1—10 to 21 inches; dark gray (10YR 4/1) silty clay loam; few fine distinct dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; firm; common fine roots; few fine black oxide stains; strongly acid; clear smooth boundary.

Cg2—21 to 32 inches; dark gray (10YR 4/1) silty clay loam; few fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; firm; few fine roots; very strongly acid; gradual smooth boundary.

Cg3—32 to 60 inches; dark gray (10YR 4/1) silty clay loam; few medium distinct dark yellowish brown (10YR 4/4) and few fine faint gray (10YR 5/1) mottles; weak fine subangular blocky structure; very firm; few fine roots; few medium black oxide stains; thin strata of silty clay; very strongly acid.

The Ap horizon has value of 4 or 5 and chroma of 1 or 2. The C horizon has value of 4 to 6 and chroma of 1 or 2.

Putnam Series

The Putnam series consists of deep, poorly drained, very slowly permeable soils on uplands. These soils formed in a thick layer of loess. Slopes range from 0 to 2 percent.

Typical pedon of Putnam silt loam, about 550 feet west and 2,625 feet north of the southeast corner of sec. 10, T. 53 N., R. 13 W.

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate very fine granular structure; very friable; common fine roots; neutral; clear smooth boundary.

E—10 to 17 inches; grayish brown (10YR 5/2) silt loam; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine granular structure; very friable; few fine roots; few fine black oxide stains; slightly acid; abrupt smooth boundary.

Btg1—17 to 26 inches; dark gray (10YR 4/1) silty clay; common fine prominent red (2.5YR 4/6) and yellowish brown (10YR 5/8) mottles; moderate medium subangular structure; firm; few distinct clay films on faces of peds; strongly acid; gradual smooth boundary.

Btg2—26 to 41 inches; grayish brown (2.5Y 5/2) silty clay; many medium prominent strong brown (7.5YR 4/6) mottles; weak fine subangular blocky structure; firm; few faint clay films on faces of peds; very strongly acid; gradual smooth boundary.

Btg3—41 to 54 inches; grayish brown (2.5Y 5/2) silty clay loam; many medium prominent strong brown (7.5YR 4/6) mottles; weak fine subangular blocky structure; firm; few faint clay films on faces of peds; strongly acid; clear smooth boundary.

Cg—54 to 60 inches; gray (10YR 5/1) silty clay loam; many medium prominent strong brown (7.5YR 4/6) mottles; weak medium subangular blocky structure; firm; strongly acid.

The solum is 45 to more than 60 inches thick. The Ap and E horizons have chroma of 1 or 2. The Cg horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 or 2. Mottles with hue of 2.5YR to 10YR, value of 4 or 5, and chroma of 4 to 8 are throughout the Btg and Cg horizons. The redder mottles are most abundant in the upper 10 inches of the Btg horizon.

Schuline Series

The Schuline series consists of deep, well drained, slowly permeable soils in upland areas that have been mined for coal. These soils formed in nonacid material mixed by surface mining activities. Slopes range from 3 to 14 percent.

The Schuline soils in this county are more acid in the upper part than is definitive for the series. This difference, however, does not significantly affect the use and management of the soils.

Typical pedon of Schuline silty clay loam, 3 to 9 percent slopes, 1,450 feet west and 1,100 feet south of the northeast corner of sec. 10, T. 54 N., R. 16 W.

Ap—0 to 10 inches; mixed dark brown (10YR 4/3) and yellowish brown (10YR 5/6) silty clay loam, brown (10YR 5/3) and yellowish brown (10YR 5/4) dry; moderate thin platy structure; very firm; many fine and few medium roots; mildly alkaline; abrupt wavy boundary.

C1—10 to 16 inches; mixed dark yellowish brown (10YR 4/6) and yellowish brown (10YR 5/6) clay loam; moderate thin platy structure; very firm; few medium roots; few thin, discontinuous, prominent horizontal strata of grayish brown (10YR 5/2) material; medium acid; abrupt wavy boundary.

C2—16 to 30 inches; mixed grayish brown (10YR 5/2) and yellowish brown (10YR 5/4 and 5/6) silty clay loam; massive; very firm; common medium roots; few thin, discontinuous, prominent horizontal strata of light gray (10YR 7/2) material; about 8 percent shale fragments; slight effervescence; mildly alkaline; abrupt wavy boundary.

C3—30 to 52 inches; mixed dark grayish brown (10YR 4/2), yellowish brown (10YR 5/6), and dark brown (7.5YR 4/4) silty clay loam; massive; very firm;

common fine roots; about 10 percent shale fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C4—52 to 60 inches; mixed dark grayish brown (10YR 4/2) and yellowish brown (10YR 5/6) silty clay loam; massive; very firm; about 12 percent shale fragments; slight effervescence; mildly alkaline.

The depth to bedrock is more than 5 feet. The A horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 to 6. The C horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 6. The content of coarse fragments in this horizon ranges from 5 to 15 percent and averages about 8 percent.

Wilbur Series

The Wilbur series consists of deep, moderately well drained, moderately permeable soils on flood plains. These soils formed in silty alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Wilbur silt loam, 2,100 feet west and 2,300 feet south of the northeast corner of sec. 23, T. 53 N., R. 13 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; very friable; many fine roots; slightly acid; gradual smooth boundary.

C1—7 to 14 inches; dark grayish brown (10YR 4/2) silt loam; many fine faint dark brown (10YR 4/3) mottles; moderate medium granular structure; very friable; many fine roots; neutral; abrupt smooth boundary.

C2—14 to 29 inches; brown (10YR 5/3) silt loam; few fine faint grayish brown (10YR 5/2) and few fine distinct dark yellowish brown (10YR 4/4) mottles; massive; friable; common fine roots; neutral; gradual smooth boundary.

C3—29 to 41 inches; mixed brown (10YR 4/3) and dark grayish brown (10YR 4/2) silt loam; few fine faint grayish brown (10YR 5/2) mottles; massive; friable; common fine roots; neutral; abrupt smooth boundary.

C4—41 to 60 inches; mixed grayish brown (10YR 5/2) and brown (10YR 4/3) silt loam; thin strata of gray (10YR 5/1) and dark grayish brown (10YR 4/2) material; massive; friable; few fine roots; neutral.

The Ap horizon has value of 4 or 5. The C horizon has mottles with value of 4 to 6 and chroma of 1 to 6.

Factors of Soil Formation

Soil forms through processes that act on accumulated or deposited geologic material. The characteristics of a soil are determined by the type of parent material; the plant and animal life on and in the soil; the climate under which the soil has formed; the relief, or lay of the land; and the length of time that the forces of soil formation have acted on the soil material. Human activities also affect soil formation.

Parent material affects the kind of soil profile that forms and, in extreme cases, determines it almost entirely. Plants and animals affect the content of organic matter, structure, and porsity of the soil. Climate determines the amount of water available for leaching and the soil temperature, which causes physical and chemical changes. Together, climate and plant and animal life act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body that has genetically related horizons. In many areas relief modifies the effects of the other factors. Finally, time is needed for the transformation of the parent material into a soil that has distinct horizons. Some time is always required for the differentiation of soil horizons. Generally, a long time is required for the formation of distinct horizons.

The effects of the factors of soil formation are so closely interrelated that few generalizations can be made about the effect of any one factor unless conditions are specified for the other four.

Parent Material

Parent material is the unconsolidated mass in which a soil forms. The characteristics of this material determine the limits of the chemical and mineralogical composition of the soils. The soils in Randolph County formed in material that weathered from bedrock; glacial till, or material deposited by glacial ice; loess, or material deposited by wind; and alluvium, or material deposited by water. Some of the soils formed in more than one kind of parent material.

The residuum in Randolph County is material weathered from limestone, shale, and sandstone. Gosport soils formed in material weathered from shale. Norris Variant soils formed in material weathered from sandstone and shale.

Glacial till is a heterogenous mass of sand, silt, clay, and rock. It ranges from a few feet to more than 200 feet in thickness. These thick layers were deposited over bedrock. Keswick and Lindley soils formed in glacial till.

Loess is silty material that probably was transported by the wind from the larger flood plains. It mantles most of the wider ridges. It ranges from a few inches to 6 feet in thickness. In the areas of prairie along the Grand Divide, the loess was deposited on wide, nearly level or gently sloping divides and ridgetops. Mexico and Putnam soils formed partly or entirely in the loess on these divides and ridgetops. The deposits of loess are thinner on narrow ridgetops. Gorin soils formed in these deposits and in the underlying glacial material.

Alluvium was deposited on nearly level flood plains along streams. Most of this material was eroded from the surrounding uplands. Chequest soils formed in silty and clayey alluvium, and Piopolis and Wilbur soils formed in silty alluvium.

Plants and Animals

Organic matter is an important component of the soil. Plants, insects, and other animals, bacteria, and fungi provide the organic matter. Chemicals in the soil move from plant roots to the parts of the plants growing above the surface. As they return to the soil and decay, leaves and other parts of plants add nutrients and organic matter. Roots help to loosen the soil. When they decay, they leave channels for the movement of water and air.

The native vegetation of prairie grasses and trees has profoundly influenced soil formation in Randolph County. The rooting habits, lifespan, and mineral composition of prairie grasses differ markedly from those of deciduous trees. The micro-organisms and animals associated with each also differ significantly.

Leaves, twigs, and logs, which tend to be acid, slowly decompose on the surface and add organic matter to soils in forested areas. These soils have a very thin, dark surface layer and a leached subsurface layer. In contrast, the organic matter added to soils that formed under prairie grasses is largely the residue from the yearly decay of annual and biennial plants. The tops of these plants decompose on the surface, but much of the organic material is roots. This material tends to have a higher mineral content than the forest residue. Thus, soils that form under prairie grasses have a dark surface layer that is much thicker than that of the forest soils. Also, the prairie soils tend to be less acid.

Worms, insects, burrowing animals, and large animals affect soil formation. The effects of bacteria and fungi, which cause the rotting of organic material, improve tilth, and fix nitrogen in the soil, are more significant than the effects of animals. The population of organisms in the soil is directly related to the rate at which organic material decomposes in the soil. The kinds of organisms in a given area and their activity are determined by differences in vegetation.

In a remarkably short time, human activities have profoundly affected soil formation in Randolph County. The major alterations have resulted from changes in vegetation, drainage, relief, and erosion. Prairie grasses have been replaced by row crops. Nearly all of the flood plains and many of the areas on uplands have been cleared and are farmed. Chemicals and lime have been applied, wet soils have been drained, and sloping soils have been terraced. A new cycle of soil formation begins in areas where huge earthmoving equipment completely rearranges soil profiles in the process of urban development. Many of these changes have increased the production of food and fiber. In terms of sustained productivity, however, the net effect of human activities has been harmful. Accelerated erosion, for example, continues to reduce the productivity of many soils on uplands.

Climate

Climate has been an important factor in the formation of the soils in Randolph County. It affects the rate of geologic erosion, which in turn affects the shape and character of landforms. The relative abundance of plants and animals and the species composition are altered by climatic changes. Present climatic conditions favor the growth of trees rather than prairie grasses.

The climate in Randolph County is subhumid midcontinental. It has changed little since the last period of glaciation. Changes in climate caused the glacial periods. During many years of cool temperatures and high precipitation, massive ice sheets formed. These ice sheets moved across a mature bedrock-controlled topography of gently undulating hills and dissected plains, which were of less relief than the current Ozark topography to the south *(16)*. Warmer temperatures later resulted in the retreat of the glacial ice. As the ice retreated, geologic erosion accelerated and the loess that covered much of the county at one time was subject to soil blowing.

Extreme changes in climate occur very slowly; therefore, there were long intermediate periods when different types of vegetation grew. Soils formed and were later covered by loess, truncated, mixed by erosion, or completely eroded away. Leonard soils, for example, formed in loess and in the underlying pedisediment or glacial till.

The higher temperatures and rainfall of the current climate result in rapid chemical changes and rapid physical disintegration. If calcium carbonates and other soluble salts are removed from the soil by leaching, the level of fertility decreases. The current climate also results in the rapid breakdown of minerals, forming clay within the soil. As the clay is moved downward, a subsoil forms. This process is known as eluviation. Nearly all of the soils on uplands show the effects of this process.

Relief

Relief refers to the general unevenness of the land surface, the variations in elevation, and the nature of the slopes between one elevation and another. The difference in elevation from a ridgetop to the adjacent valley floor varies, depending on the parent material and the position in the watershed.

Relief influences soil formation mainly through its effect on drainage, runoff, erosion, and, to some extent, exposure to sunlight and wind. The length, shape, and gradient of slopes affect soil-water relationships. The amount of water entering and passing through the soil depends on the slope, the position on the landscape, the permeability of the soil, and the amount and intensity of rainfall.

On nearly level or gently sloping soils in the uplands, runoff is slow and most of the water that the soils receive passes through the profile. As a result, these soils are characterized by maximum profile development. Over long periods a subsoil high in content of clay forms under a leached subsurface layer. This kind of development has occurred in Putnam soils. On the steeper soils, such as Gosport, runoff is rapid and very little water passes through the profile. Consequently, distinct horizons do not develop. The results of weathering are almost immediately eliminated by geologic erosion.

Time

Time allows climate, living organisms, and relief to affect the parent material. The degree to which the parent material is altered determines the age of a soil. Thus, the age is inferred from the morphology of the soil.

The most fertile and productive soils in the county formed in recent alluvium. They are young soils. Piopolis and Wilbur soils are examples.

Soils on terraces are intermediate in age between the soils on flood plains and those on uplands. Moniteau soils, for example, exhibit some maturity, as is indicated by a reduced level of fertility and by the formation of an argillic horizon.

Soils on uplands generally show evidence of maturity, as is indicated by a reduced level of fertility and a strongly expressed argillic horizon. These soils tend to be on the older landforms. Nearly level to gently sloping soils at the highest elevations are the oldest soils in the county. They are characterized by the maximum development of distinct horizons. Mexico and Putnam soils are examples. The carbonates that originally were in the parent material of these soils have been leached to a great depth, leaving the soils quite acid throughout. Clay has formed through weathering and has been translocated by water into a distinct subsoil. A highly bleached subsurface layer generally forms if water is perched for long periods above a relatively impervious subsoil.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Basal till. Compact glacial till deposited beneath the ice.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bedrock-controlled topography. A landscape where the configuration and relief of the landforms are determined or strongly influenced by the underlying bedrock.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on the contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Catsteps. Very small, irregular terraces on steep hillsides, especially in pasture, formed by the trampling of cattle or the slippage of saturated soil.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.
Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.
Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.
Coarse textured soil. Sand or loamy sand.
Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.
Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.
Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.
Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.
Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.
Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.
Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—
Loose.—Noncoherent when dry or moist; does not hold together in a mass.
Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.
Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.
Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.
Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.
Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.
Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.
Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.
Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.
Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.
Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.
Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.
Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:
Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.
Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.
Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.
Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly

have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedisediment. A thin layer of alluvial material that mantles an erosion surface and has been transported to its present position from higher lying areas of the erosion surface.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Root zone. The part of the soil that can be penetrated by plant roots.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-81 at Moberly, Missouri)

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January-----	35.8	16.6	26.2	64	-12	0	1.43	0.39	2.26	3	4.9
February----	41.8	21.9	31.9	69	-8	10	1.57	.77	2.26	4	4.4
March-------	52.3	30.5	41.4	81	4	57	2.95	1.24	4.40	6	3.6
April-------	66.7	43.4	55.1	87	23	195	3.97	2.00	5.68	7	.3
May---------	75.7	52.9	64.3	91	33	443	4.42	2.90	5.80	8	.0
June--------	84.3	61.8	73.1	97	46	693	4.19	1.81	6.21	7	.0
July--------	89.1	66.0	77.6	102	50	856	4.57	1.66	6.98	6	.0
August------	87.6	63.5	75.6	101	48	794	3.61	1.69	5.26	6	.0
September---	80.5	55.9	68.2	96	37	546	3.68	1.66	5.44	6	.0
October-----	69.2	45.1	57.2	89	24	252	3.32	1.11	5.13	5	.0
November----	53.7	32.8	43.3	78	9	34	1.99	.66	3.07	4	1.3
December----	41.3	23.0	32.2	67	-6	6	1.67	.77	2.44	4	4.2
Yearly:											
Average---	64.8	42.8	53.8	---	---	---	---	---	---	---	---
Extreme---	---	---	---	105	-14	---	---	---	---	---	---
Total-----	---	---	---	---	---	3,886	37.37	29.98	44.13	66	18.7

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1951-81 at Moberly, Missouri)

Probability	Temperature		
	24^{o} F or lower	28^{o} F or lower	32^{o} F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 7	Apr. 22	Apr. 30
2 years in 10 later than--	Apr. 4	Apr. 17	Apr. 25
5 years in 10 later than--	Mar. 28	Apr. 8	Apr. 16
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 23	Oct. 13	Oct. 6
2 years in 10 earlier than--	Oct. 28	Oct. 18	Oct. 11
5 years in 10 earlier than--	Nov. 6	Oct. 28	Oct. 20

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-81 at Moberly, Missouri)

Probability	Daily minimum temperature during growing season		
	Higher than 24^{o} F	Higher than 28^{o} F	Higher than 32^{o} F
	Days	Days	Days
9 years in 10	205	180	167
8 years in 10	211	188	174
5 years in 10	222	203	185
2 years in 10	233	218	197
1 year in 10	239	225	204

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
15B2	Calwoods silt loam, 2 to 5 percent slopes, eroded	13,065	4.2
16C2	Lagonda silt loam, 5 to 9 percent slopes, eroded	12,660	4.0
18C2	Gorin silt loam, 5 to 9 percent slopes, eroded	24,545	7.9
19E2	Gosport silt loam, 14 to 30 percent slopes, eroded	29,585	9.5
23C2	Keswick silt loam, 5 to 9 percent slopes, eroded	25,170	8.1
23E2	Keswick silt loam, 9 to 20 percent slopes, eroded	57,265	18.3
24E	Norris Variant-Gosport complex, 14 to 35 percent slopes	7,160	2.3
26B2	Leonard silt loam, 2 to 6 percent slopes, eroded	30,320	9.7
27E	Lindley loam, 14 to 30 percent slopes	16,330	5.2
30B	Mexico silt loam, 1 to 4 percent slopes	38,495	12.3
31	Putnam silt loam	8,150	2.6
34B	Grundy silt loam, 2 to 5 percent slopes	3,705	1.2
42	Bremer silt loam	2,830	0.9
45A	Moniteau silt loam, 0 to 3 percent slopes	3,745	1.2
51	Wilbur silt loam	7,250	2.3
53	Chequest silty clay loam	3,030	1.0
55	Piopolis silty clay loam	13,870	4.4
60E	Bethesda shaly silt loam, 9 to 20 percent slopes	3,040	1.0
60F	Bethesda shaly silt loam, 20 to 70 percent slopes	4,955	1.6
62C	Schuline silty clay loam, 3 to 9 percent slopes	2,065	0.7
62D	Schuline silty clay loam, 9 to 14 percent slopes	490	0.2
64	Udorthents-Pits complex	735	0.2
	Water	3,770	1.2
	Total	312,230	100.0

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
15B2	Calwoods silt loam, 2 to 5 percent slopes, eroded (where drained)
26B2	Leonard silt loam, 2 to 6 percent slopes, eroded (where drained)
30B	Mexico silt loam, 1 to 4 percent slopes (where drained)
31	Putnam silt loam (where drained)
34B	Grundy silt loam, 2 to 5 percent slopes
42	Bremer silt loam (where drained)
45A	Moniteau silt loam, 0 to 3 percent slopes (where drained)
51	Wilbur silt loam (where protected from flooding or not frequently flooded during the growing season)
53	Chequest silty clay loam (where drained and either protected from flooding or not frequently flooded during the growing season)
55	Piopolis silty clay loam (where drained and either protected from flooding or not frequently flooded during the growing season)

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Corn	Soybeans	Grain sorghum	Winter wheat	Tall fescue-red clover hay	Tall fescue
		Bu	Bu	Bu	Bu	Tons	AUM*
15B2------------ Calwoods	IIIe	80	30	78	40	3.0	7.2
16C2------------ Lagonda	IIIe	90	33	78	37	3.9	7.8
18C2------------ Gorin	IIIe	70	25	62	28	3.3	6.6
19E2------------ Gosport	VIIe	---	---	---	---	1.3	3.0
23C2------------ Keswick	IIIe	70	25	65	30	3.0	6.6
23E2------------ Keswick	VIe	---	---	---	---	2.7	5.4
24E------------- Norris Variant-Gosport	VIIe	---	---	---	---	---	3.6
26B2------------ Leonard	IIIe	80	30	70	32	3.1	7.2
27E------------- Lindley	VIIe	---	---	---	---	3.3	6.6
30B------------- Mexico	IIe	90	33	80	36	4.0	8.0
31-------------- Putnam	IIw	90	35	78	38	4.0	8.0
34B------------- Grundy	IIe	101	38	85	40	4.4	9.0
42-------------- Bremer	IIw	108	40	94	44	4.8	9.6
45A------------- Moniteau	IIIw	90	35	60	30	4.5	9.0
51-------------- Wilbur	IIw	90	35	83	38	4.1	7.8
53-------------- Chequest	IIw	81	30	71	31	3.6	7.2
55-------------- Piopolis	IIIw	90	36	90	45	4.2	8.4
60E------------- Bethesda	VIe	---	---	---	---	---	---
60F------------- Bethesda	VIIe	---	---	---	---	---	---

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Grain sorghum	Winter wheat	Tall fescue-red clover hay	Tall fescue
		Bu	Bu	Bu	Bu	Tons	AUM*
62C------------- Schuline	IIIe	91	31	80	33	3.6	7.5
62D------------- Schuline	IIIe	88	30	76	32	3.5	7.0
64**. Udorthents-Pits							

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.
** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

(Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available)

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
15B2------------ Calwoods	3C	Slight	Slight	Moderate	Moderate	White oak-----------	55	38	White oak, pin oak, green ash, black oak, eastern redcedar, red pine.
18C2------------ Gorin	3C	Slight	Slight	Moderate	Moderate	White oak-----------	55	38	White oak, green ash, pin oak, black oak, eastern redcedar.
19E2------------ Gosport	2R	Moderate	Moderate	Severe	Severe	White oak-----------	55	38	Eastern white pine, white oak, northern red oak, black locust.
23C2------------ Keswick	3C	Slight	Slight	Moderate	Moderate	White oak----------- Northern red oak----	55 55	38 38	Eastern white pine, red pine, sugar maple.
23E2------------ Keswick	3R	Moderate	Moderate	Moderate	Moderate	White oak----------- Northern red oak----	55 55	38 38	Eastern white pine, red pine, sugar maple.
24E**:									
Norris Variant-	2R	Severe	Moderate	Moderate	Severe	White oak----------- Black oak----------- Northern red oak----	49 --- ---	33 --- ---	Eastern redcedar, green ash.
Gosport--------	3R	Moderate	Moderate	Severe	Severe	White oak-----------	55	38	Eastern white pine, white oak, northern red oak, black locust.
27E------------- Lindley	3R	Moderate	Moderate	Slight	Slight	White oak----------- Post oak------------ Black oak----------- Northern red oak----	60 --- --- ---	43 --- --- ---	White oak, green ash, northern red oak, black oak.
42-------------- Bremer	7W	Slight	Severe	Moderate	Moderate	Eastern cottonwood-- Silver maple--------	90 80	103 34	American sycamore, hackberry, green ash, eastern cottonwood, silver maple.

See footnotes at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
45A------------- Moniteau	4W	Slight	Severe	Moderate	Moderate	Pin oak-------------	70	52	White oak, pin oak, green ash, eastern cottonwood, silver maple.
51-------------- Wilbur	9A	Slight	Slight	Slight	Slight	Eastern cottonwood--	100	128	Eastern white pine, black walnut, green ash.
53-------------- Chequest	7W	Slight	Severe	Moderate	Moderate	Eastern cottonwood-- Silver maple--------	90 80	103 34	Eastern cottonwood, silver maple, American sycamore, green ash.
55-------------- Piopolis	5W	Slight	Severe	Severe	Severe	Pin oak------------- Eastern cottonwood-- American sycamore--- Post oak------------	90 100 --- ---	72 128 --- ---	Eastern cottonwood, silver maple, American sycamore, pin oak.
60E, 60F-------- Bethesda	---	--------	--------	--------	--------	Black locust-------- Pin oak------------- Eastern cottonwood--	--- --- ---	--- --- ---	Black locust, pin oak, eastern cottonwood.
62C, 62D-------- Schuline	---	--------	--------	--------	--------	-------------------	---	---	Black walnut, eastern white pine, green ash, loblolly pine, northern red oak, white ash, white oak.

* Volume is the yield in cubic feet per acre per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
15B2 Calwoods	---	Amur honeysuckle, Amur privet, eastern redcedar, Washington hawthorn, arrowwood, Tatarian honeysuckle, American cranberrybush.	Austrian pine, Osageorange, green ash.	Pin oak, eastern white pine.	---
16C2 Lagonda	---	Amur honeysuckle, Washington hawthorn, Amur privet, arrowwood, eastern redcedar, Tatarian honeysuckle, American cranberrybush.	Austrian pine, Osageorange, green ash.	Pin oak, eastern white pine.	---
18C2 Gorin	---	Amur honeysuckle, Washington hawthorn, eastern redcedar, Amur privet, arrowwood, American cranberrybush, Tatarian honeysuckle.	Green ash, Austrian pine, Osageorange.	Pin oak, eastern white pine.	---
19E2 Gosport	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, Amur honeysuckle, Tatarian honeysuckle, American cranberrybush.	Austrian pine, green ash, Osageorange.	Eastern white pine, pin oak.	---
23C2, 23E2 Keswick	---	Eastern redcedar, Tatarian honeysuckle, Washington hawthorn, arrowwood, Amur privet, Amur honeysuckle, American cranberrybush.	Austrian pine, green ash, Osageorange.	Eastern white pine, pin oak.	---
24E*: Norris Variant.					

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
24E*: Gosport	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, Amur honeysuckle, Tatarian honeysuckle, American cranberrybush.	Austrian pine, green ash, Osageorange.	Eastern white pine, pin oak.	---
26B2 Leonard	---	Amur honeysuckle, Amur privet, eastern redcedar, Tatarian honeysuckle, Washington hawthorn, arrowwood, American cranberrybush.	Austrian pine, green ash, Osageorange.	Eastern white pine, pin oak.	---
27E Lindley	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Northern white-cedar, Washington hawthorn, blue spruce, white fir.	Norway spruce, Austrian pine.	Pin oak, eastern white pine.
30B Mexico	---	Amur honeysuckle, American cranberrybush, Tatarian honeysuckle, arrowwood, eastern redcedar, Amur privet, Washington hawthorn.	Green ash, Osageorange, Austrian pine.	Eastern white pine, pin oak.	---
31 Putnam	---	American cranberrybush, Amur honeysuckle, Amur privet, silky dogwood.	Norway spruce, Austrian pine, northern white-cedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
34B Grundy	---	Washington hawthorn, Tatarian honeysuckle, Amur honeysuckle, Amur privet, American cranberrybush, arrowwood, eastern redcedar.	Austrian pine, Osageorange, green ash.	Pin oak, eastern white pine.	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
42. Bremer	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Norway spruce, Austrian pine, blue spruce, white fir, northern white-cedar, Washington hawthorn.	Eastern white pine	Pin oak.
45A. Moniteau	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, northern white-cedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
51. Wilbur	---	Amur honeysuckle, American cranberrybush, Amur privet, silky dogwood.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.
53. Chequest	---	Amur privet, silky dogwood, Amur honeysuckle, American cranberrybush.	Norway spruce, Austrian pine, northern white-cedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
55. Piopolis	---	Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet.	Washington hawthorn, white fir, blue spruce, northern white-cedar, Austrian pine, Norway spruce.	Eastern white pine	Pin oak.
60E, 60F. Bethesda					
62C, 62D. Schuline	Siberian peashrub, Tatarian honeysuckle.	Eastern redcedar, jack pine, Washington hawthorn, Osageorange, Russian olive.	Honeylocust, northern catalpa.	---	---
64*:					
Udorthents.					
Pits.					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
15B2----------------- Calwoods	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
16C2----------------- Lagonda	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Moderate: wetness.	Moderate: wetness.
18C2----------------- Gorin	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Slight----------	Slight.
19E2----------------- Gosport	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: erodes easily.	Severe: slope.
23C2----------------- Keswick	Severe: wetness.	Moderate: wetness.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
23E2----------------- Keswick	Severe: slope, wetness.	Severe: slope.	Severe: slope, wetness.	Severe: erodes easily.	Severe: slope.
24E*:					
Norris Variant-------	Severe: slope, thin layer, area reclaim.	Severe: slope, thin layer, area reclaim.	Severe: slope, thin layer, area reclaim.	Moderate: slope.	Severe: slope, thin layer, area reclaim.
Gosport-------------	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: erodes easily.	Severe: slope.
26B2----------------- Leonard	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
27E------------------ Lindley	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
30B------------------ Mexico	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
31------------------- Putnam	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
34B------------------ Grundy	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
42------------------- Bremer	Severe: wetness, flooding.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
45A------------------ Moniteau	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
51------------------- Wilbur	Severe: flooding.	Moderate: flooding, wetness.	Severe: flooding.	Moderate: flooding, wetness.	Severe: flooding.
53------------------- Chequest	Severe: wetness, flooding.	Moderate: flooding, wetness, percs slowly.	Severe: wetness, flooding.	Moderate: wetness, flooding.	Severe: flooding.
55------------------- Piopolis	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding, flooding.	Severe: ponding.	Severe: ponding, flooding.
60E------------------ Bethesda	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.	Severe: droughty, slope.
60F------------------ Bethesda	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.	Severe: droughty, slope.
62C------------------ Schuline	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight----------	Slight.
62D------------------ Schuline	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
64*: Udorthents.					
Pits.					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
15B2---------------- Calwoods	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
16C2---------------- Lagonda	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
18C2---------------- Gorin	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
19E2---------------- Gosport	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
23C2---------------- Keswick	Fair	Good	Fair	Good	Fair	Very poor.	Poor	Fair	Good	Very poor.
23E2---------------- Keswick	Poor	Fair	Fair	Good	Fair	Very poor.	Very poor.	Fair	Good	Very poor.
24E*:										
Norris Variant----	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Gosport-----------	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
26B2---------------- Leonard	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
27E----------------- Lindley	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
30B----------------- Mexico	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
31------------------ Putnam	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
34B----------------- Grundy	Fair	Good	Fair	Good	Good	Fair	Fair	Fair	Good	Fair.
42------------------ Bremer	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
45A----------------- Moniteau	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
51------------------ Wilbur	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
53------------------ Chequest	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
55------------------ Piopolis	Poor	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
60E, 60F----------- Bethesda	Very poor.	Very poor.	Poor	Poor	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.
62C, 62D----------- Schuline	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
64*:										
Udorthents.										
Pits.										

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
15B2 Calwoods	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
16C2 Lagonda	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
18C2 Gorin	Severe: wetness.	Severe: shrink-swell.	Severe: wetness.	Severe: shrink-swell.	Severe: low strength, frost action, shrink-swell.	Slight.
19E2 Gosport	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope.
23C2 Keswick	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength.	Moderate: wetness.
23E2 Keswick	Severe: wetness, slope.	Severe: wetness, shrink-swell, slope.	Severe: wetness, slope.	Severe: wetness, shrink-swell, slope.	Severe: shrink-swell, low strength, slope.	Severe: slope.
24E*:						
Norris Variant	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, thin layer, area reclaim.
Gosport	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope.
26B2 Leonard	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
27E Lindley	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
30B Mexico	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength.	Moderate: wetness.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
31---------------- Putnam	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.
34B--------------- Grundy	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
42---------------- Bremer	Severe: wetness.	Severe: wetness, shrink-swell, flooding.	Severe: wetness, shrink-swell, flooding.	Severe: wetness, shrink-swell, flooding.	Severe: shrink-swell, low strength.	Moderate: wetness.
45A--------------- Moniteau	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
51---------------- Wilbur	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding, frost action.	Severe: flooding.
53---------------- Chequest	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, low strength, shrink-swell.	Severe: flooding.
55---------------- Piopolis	Severe: ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: low strength, ponding, flooding.	Severe: ponding, flooding.
60E, 60F---------- Bethesda	Severe: slope.	Severe: slope, unstable fill.	Severe: slope, unstable fill.	Severe: slope, unstable fill.	Severe: slope, unstable fill.	Severe: droughty, slope.
62C--------------- Schuline	Moderate: too clayey, dense layer.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
62D--------------- Schuline	Moderate: too clayey, dense layer, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
64*: Udorthents.						
Pits.						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
15B2----------------- Calwoods	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
16C2----------------- Lagonda	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
18C2----------------- Gorin	Severe: wetness, percs slowly.	Moderate: slope.	Moderate: wetness, too clayey.	Moderate: wetness.	Poor: thin layer.
19E2----------------- Gosport	Severe: thin layer, seepage, percs slowly.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: slope.	Poor: area reclaim, hard to pack, slope.
23C2----------------- Keswick	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness.	Severe: wetness.	Poor: wetness.
23E2----------------- Keswick	Severe: wetness, percs slowly, slope.	Severe: slope.	Severe: wetness, slope.	Severe: wetness, slope.	Poor: slope, wetness.
24E*:					
Norris Variant-----	Severe: thin layer, seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: area reclaim, thin layer, slope.
Gosport------------	Severe: thin layer, seepage, percs slowly.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: slope.	Poor: area reclaim, hard to pack, slope.
26B2----------------- Leonard	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
27E------------------ Lindley	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
30B------------------ Mexico	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
31----------------- Putnam	Severe: wetness, percs slowly.	Slight-----------	Severe: wetness, too clayey.	Severe: wetness.	Poor: wetness, hard to pack, too clayey.
34B---------------- Grundy	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
42----------------- Bremer	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
45A---------------- Moniteau	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
51----------------- Wilbur	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: wetness.
53----------------- Chequest	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: wetness, hard to pack, too clayey.
55----------------- Piopolis	Severe: flooding, ponding, percs slowly.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Poor: ponding.
60E, 60F----------- Bethesda	Severe: percs slowly, slope, unstable fill.	Severe: slope, unstable fill.	Severe: slope, unstable fill.	Severe: slope, unstable fill.	Poor: small stones, slope.
62C---------------- Schuline	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey, small stones.
62D---------------- Schuline	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, small stones, slope.
64*: Udorthents.					
Pits.					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
15B2------------------ Calwoods	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
16C2------------------ Lagonda	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
18C2------------------ Gorin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
19E2------------------ Gosport	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
23C2------------------ Keswick	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
23E2------------------ Keswick	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
24E*:				
Norris Variant-------	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope, thin layer.
Gosport--------------	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
26B2------------------ Leonard	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
27E------------------- Lindley	Fair: slope, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
30B------------------- Mexico	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
31-------------------- Putnam	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
34B------------------- Grundy	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
42 Bremer	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
45A Moniteau	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
51 Wilbur	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
53 Chequest	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
55 Piopolis	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
60E Bethesda	Fair: large stones, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
60F Bethesda	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
62C, 62D Schuline	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
64*: Udorthents.				
Pits.				

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
15B2 Calwoods	Moderate: slope.	Severe: hard to pack.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
16C2 Lagonda	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Erodes easily, percs slowly.
18C2 Gorin	Moderate: slope.	Moderate: thin layer, piping, wetness.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Erodes easily, percs slowly.
19E2 Gosport	Severe: slope.	Severe: hard to pack.	Deep to water	Slope, percs slowly, thin layer.	Slope, area reclaim, erodes easily.	Slope, erodes easily, area reclaim.
23C2 Keswick	Moderate: slope.	Moderate: wetness.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Wetness, erodes easily.
23E2 Keswick	Severe: slope.	Moderate: wetness.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Slope, erodes easily, wetness.	Wetness, slope, erodes easily.
24E*:						
Norris Variant	Severe: seepage, slope.	Severe: piping, thin layer.	Deep to water	Slope, thin layer.	Slope, area reclaim.	Slope, area reclaim.
Gosport	Severe: slope.	Severe: hard to pack.	Deep to water	Slope, percs slowly, thin layer.	Slope, area reclaim, erodes easily.	Slope, erodes easily, area reclaim.
26B2 Leonard	Moderate: slope.	Severe: wetness.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Wetness, erodes easily.
27E Lindley	Severe: slope.	Moderate: piping.	Deep to water	Slope	Slope	Slope.
30B Mexico	Slight	Moderate: hard to pack, wetness.	Percs slowly	Wetness, percs slowly.	Erodes easily, wetness.	Wetness, erodes easily, percs slowly.
31 Putnam	Slight	Severe: wetness.	Percs slowly	Wetness, percs slowly, erodes easily.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
34B Grundy	Moderate: slope.	Severe: hard to pack.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Wetness, erodes easily.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
42 Bremer	Slight	Severe: wetness, hard to pack.	Frost action	Wetness	Wetness	Wetness.
45A Moniteau	Slight	Severe: wetness.	Frost action	Wetness, erodes easily.	Erodes easily, wetness.	Wetness, erodes easily.
51 Wilbur	Moderate: seepage.	Severe: piping, wetness.	Flooding, frost action.	Wetness, erodes easily, flooding.	Erodes easily, wetness.	Erodes easily.
53 Chequest	Slight	Severe: wetness.	Flooding, frost action.	Flooding, wetness.	Wetness, erodes easily.	Wetness, erodes easily.
55 Piopolis	Slight	Severe: ponding.	Ponding, percs slowly, flooding.	Ponding, percs slowly, erodes easily.	Erodes easily, ponding, percs slowly.	Wetness, erodes easily, percs slowly.
60E, 60F Bethesda	Severe: slope.	Severe: seepage, piping.	Deep to water	Large stones, droughty, rooting depth.	Slope, large stones, slippage.	Large stones, slope, droughty.
62C Schuline	Moderate: slope.	Moderate: thin layer, piping.	Deep to water	Percs slowly, rooting depth, slope.	Erodes easily	Erodes easily, rooting depth.
62D Schuline	Severe: slope.	Moderate: thin layer, piping.	Deep to water	Percs slowly, rooting depth, slope.	Slope, erodes easily.	Slope, erodes easily, rooting depth.
64*: Udorthents.						
Pits.						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
15B2------------- Calwoods	0-5	Silt loam--------	CL	A-6, A-7	0	100	100	95-100	90-100	30-45	15-25
	5-10	Silty clay loam	CL, CH	A-7	0	100	100	95-100	90-100	45-55	25-35
	10-34	Silty clay, clay	CH	A-7	0	100	100	95-100	95-100	60-75	40-50
	34-46	Silty clay loam	CL, CH	A-7	0	100	100	95-100	95-100	45-55	25-35
	46-60	Silty clay loam, clay loam.	CL, CH	A-7	0	95-100	90-100	85-95	75-90	45-55	25-35
16C2------------- Lagonda	0-8	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	90-100	20-40	5-15
	8-11	Silty clay loam	CL	A-7	0	100	100	95-100	90-100	40-50	15-25
	11-21	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	95-100	95-100	40-70	25-40
	21-42	Silty clay loam, silty clay, clay loam.	CL, CH	A-7	0	95-100	90-100	80-95	75-90	45-60	25-40
	42-60	Clay loam, clay	CL, CH	A-7	0	95-100	90-100	90-100	75-90	40-65	25-40
18C2------------- Gorin	0-4	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-18
	4-19	Silty clay loam, silty clay.	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	15-30
	19-27	Silty clay-------	CH	A-7	0	100	100	95-100	90-100	50-65	30-40
	27-48	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	100	80-95	70-90	30-50	12-30
	48-60	Clay-------------	CH, CL	A-7	0	95-100	95-100	90-100	85-100	45-70	30-45
19E2------------- Gosport	0-5	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	90-100	90-100	70-100	25-40	5-15
	5-36	Clay, silty clay, silty clay loam.	CH	A-7	0	100	90-100	90-100	85-100	50-65	35-50
	36-60	Weathered bedrock	CH	A-7	0	100	100	95-100	85-100	65-80	50-60
23C2, 23E2------- Keswick	0-5	Silt loam--------	CL, CL-ML	A-6, A-4	0-5	90-100	80-100	75-90	60-80	20-30	5-15
	5-37	Clay loam, clay	CH, MH	A-7	0-5	90-100	80-100	70-90	55-80	50-60	20-30
	37-60	Clay loam--------	CL	A-6	0-5	90-100	80-100	70-90	55-80	30-40	15-25
24E*:											
Norris Variant--	0-3	Fine sandy loam	CL, SC, SM-SC, CL-ML	A-4	0-5	95-100	90-100	70-95	40-75	20-30	5-10
	3-16	Loamy fine sand	SM, SM-SC	A-2	5-10	90-100	90-100	65-80	20-35	15-20	NP-5
	16-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Gosport---------	0-2	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	90-100	90-100	70-100	25-40	5-15
	2-36	Clay, silty clay, silty clay loam.	CH	A-7	0	100	90-100	90-100	85-100	50-65	35-50
	36-60	Weathered bedrock	CH	A-7	0	100	100	95-100	85-100	65-80	50-60
26B2------------- Leonard	0-7	Silt loam--------	CL	A-6, A-7	0	100	95-100	90-100	85-100	30-45	15-25
	7-11	Silty clay loam, silty clay.	CL	A-6, A-7	0	100	95-100	90-100	85-100	35-50	20-30
	11-28	Silty clay, clay, silty clay loam.	CH	A-7	0	100	95-100	85-100	80-100	55-70	30-40
	28-60	Silty clay, clay loam, silty clay loam.	CL, CH	A-7	0	95-100	95-100	80-95	75-90	45-60	25-35
27E-------------- Lindley	0-8	Loam-------------	CL	A-6	0	95-100	90-100	85-95	50-65	25-35	10-15
	8-49	Clay loam, loam	CL	A-6, A-7	0	95-100	90-100	85-95	55-75	30-45	12-20
	49-60	Loam, clay loam	CL	A-6	0	95-100	90-100	85-95	50-70	25-35	10-15

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
30B--------------- Mexico	0-8	Silt loam---------	CL-ML, CL	A-4, A-6	0	100	100	95-100	90-100	25-40	5-15
	8-11	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	95-100	90-100	45-60	25-35
	11-36	Silty clay, clay	CH	A-7	0	100	100	95-100	95-100	60-75	30-45
	36-53	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	95-100	90-100	45-60	25-35
	53-60	Silty clay loam, clay loam, silty clay.	CL, CH	A-7	0	100	95-100	90-100	70-100	40-65	15-40
31--------------- Putnam	0-10	Silt loam---------	CL, ML	A-6, A-4	0	100	100	90-100	85-100	30-40	5-15
	10-17	Silt loam---------	CL, ML	A-4, A-6	0	100	100	90-100	85-100	30-40	5-15
	17-41	Silty clay--------	CH	A-7	0	100	100	95-100	90-100	60-70	35-45
	41-54	Silty clay loam, silty clay.	CH	A-7	0	100	100	95-100	90-100	50-65	25-40
	54-60	Silty clay loam	CL	A-7	0	100	100	95-100	90-100	40-50	20-30
34B--------------- Grundy	0-16	Silt loam---------	CL	A-6, A-7	0	100	100	95-100	90-100	30-45	10-20
	16-36	Silty clay--------	CH	A-7	0	100	100	95-100	90-100	50-70	30-45
	36-60	Silty clay loam, clay loam.	CH, CL	A-7	0	100	100	90-100	90-100	40-55	25-35
42--------------- Bremer	0-8	Silt loam---------	CH, CL	A-7	0	100	100	100	95-100	45-60	25-40
	8-46	Silty clay loam, silty clay.	CH, MH	A-7	0	100	100	100	95-100	50-65	20-35
	46-60	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	40-60	25-40
45A--------------- Moniteau	0-15	Silt loam---------	CL-ML, CL	A-4, A-6	0	100	100	90-100	85-100	25-35	5-15
	15-49	Silty clay loam	CL	A-6, A-7	0	100	100	85-100	80-95	30-45	15-25
	49-60	Silt loam, silty clay loam.	CL-ML, CL, ML	A-4, A-6	0	100	100	85-100	75-100	25-40	5-15
51--------------- Wilbur	0-7	Silt loam---------	ML, CL-ML	A-4	0	100	100	90-100	70-90	<25	3-7
	7-60	Silt loam---------	ML, CL-ML	A-4	0	100	100	90-100	70-90	<25	3-7
53--------------- Chequest	0-9	Silty clay loam	CL	A-7	0	100	100	98-100	95-100	40-50	15-25
	9-60	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	98-100	90-100	45-60	20-30
55--------------- Piopolis	0-10	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	75-95	35-50	15-25
	10-60	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	85-95	35-50	15-25
60E, 60F--------- Bethesda	0-5	Shaly silt loam	ML, GM, GM-GC, CL-ML	A-4, A-6	0-15	65-90	55-80	50-80	35-75	25-40	4-14
	5-60	Very shaly clay loam, silty clay loam.	GM, GC, ML, CL	A-4, A-6, A-7, A-2	10-30	40-80	25-65	20-65	18-60	24-50	3-23
62C, 62D--------- Schuline	0-10	Silty clay loam	CL	A-6, A-7	0-2	90-100	85-100	80-95	70-85	30-50	10-25
	10-60	Loam, silty clay loam, clay loam.	CL	A-6, A-7	0-5	90-100	85-100	80-95	70-85	30-50	10-25
64*: Udorthents.											
Pits.											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
15B2------------- Calwoods	0-5	15-27	1.40-1.50	0.6-2.0	0.22-0.24	4.5-7.3	Low----------	0.37	3	6	1-2
	5-10	27-36	1.35-1.45	0.2-0.6	0.18-0.20	4.5-5.5	Moderate-----	0.37			
	10-34	45-60	1.30-1.40	<0.06	0.11-0.13	4.5-5.5	High---------	0.37			
	34-46	28-39	1.35-1.45	<0.06	0.14-0.18	4.5-6.5	Moderate-----	0.37			
	46-60	28-35	1.35-1.50	<0.06	0.18-0.20	5.6-7.3	Moderate-----	0.37			
16C2------------- Lagonda	0-8	12-27	1.35-1.50	0.6-2.0	0.21-0.24	5.6-6.5	Moderate-----	0.37	3	6	2-4
	8-11	27-35	1.35-1.50	0.2-0.6	0.18-0.20	5.6-6.5	Moderate-----	0.37			
	11-21	32-50	1.30-1.40	0.06-0.2	0.13-0.18	5.6-7.3	High---------	0.37			
	21-42	35-45	1.30-1.40	0.06-0.2	0.10-0.18	6.6-7.8	High---------	0.37			
	42-60	28-45	1.30-1.40	0.06-0.2	0.08-0.16	6.6-7.8	High---------	0.37			
18C2------------- Gorin	0-4	12-27	1.30-1.50	0.6-2.0	0.22-0.24	5.1-7.3	Moderate-----	0.43	3	6	.5-1
	4-19	27-42	1.30-1.45	0.06-0.6	0.18-0.20	4.5-6.0	Moderate-----	0.32			
	19-27	45-60	1.30-1.40	0.06-0.2	0.11-0.13	4.5-6.0	High---------	0.32			
	27-48	27-40	1.30-1.45	0.2-0.6	0.18-0.20	4.5-6.0	Moderate-----	0.32			
	48-60	40-60	1.30-1.40	<0.06	0.10-0.12	4.5-6.0	High---------	0.32			
19E2------------- Gosport	0-5	18-27	1.30-1.40	0.2-0.6	0.18-0.20	4.5-6.5	Low----------	0.43	3	6	1-2
	5-36	36-60	1.50-1.60	<0.06	0.12-0.14	3.6-5.5	High---------	0.32			
	36-60	40-75	1.70-1.90	<0.06	0.08-0.10	3.6-5.5	High---------	----			
23C2, 23E2------- Keswick	0-5	22-27	1.45-1.50	0.6-2.0	0.17-0.22	4.5-7.3	Moderate-----	0.37	3	6	1-2
	5-37	35-48	1.45-1.60	0.06-0.2	0.11-0.15	4.5-6.0	High---------	0.37			
	37-60	30-40	1.60-1.80	0.2-0.6	0.12-0.16	4.5-7.3	Moderate-----	0.37			
24E*:											
Norris Variant--	0-3	10-20	1.20-1.40	2.0-6.0	0.16-0.18	5.6-6.5	Low----------	0.24	2	5	1-2
	3-16	5-15	1.20-1.40	>6.0	0.10-0.12	4.5-6.0	Low----------	0.17			
	16-60	---	---	---	---	---	-------------	----			
Gosport---------	0-2	18-27	1.30-1.40	0.2-0.6	0.18-0.20	5.1-6.5	Low----------	0.43	3	6	1-2
	2-36	36-60	1.50-1.60	<0.06	0.12-0.14	3.6-5.5	High---------	0.32			
	36-60	40-75	1.70-1.90	<0.06	0.08-0.10	3.6-5.5	High---------	----			
26B2------------- Leonard	0-7	20-35	1.20-1.40	0.2-0.6	0.22-0.24	6.1-7.3	Moderate-----	0.37	3	6	2-4
	7-11	35-45	1.30-1.45	0.06-0.2	0.11-0.13	4.5-6.5	High---------	0.37			
	11-28	35-45	1.20-1.35	0.06-0.2	0.10-0.12	4.5-6.5	High---------	0.37			
	28-60	32-45	1.25-1.40	0.06-0.2	0.11-0.14	6.1-7.8	High---------	0.37			
27E-------------- Lindley	0-8	18-27	1.20-1.40	0.6-2.0	0.16-0.18	4.5-7.3	Low----------	0.32	5	6	1-2
	8-49	25-35	1.40-1.60	0.2-0.6	0.14-0.18	4.5-6.5	Moderate-----	0.32			
	49-60	18-32	1.45-1.65	0.2-0.6	0.12-0.16	6.1-7.8	Moderate-----	0.32			
30B-------------- Mexico	0-8	15-27	1.20-1.40	0.6-2.0	0.22-0.24	5.1-7.3	Low----------	0.43	3	6	2-4
	8-11	35-50	1.25-1.45	0.2-0.6	0.12-0.16	4.5-6.0	High---------	0.32			
	11-36	50-60	1.25-1.45	<0.06	0.08-0.12	4.5-6.0	High---------	0.32			
	36-53	35-50	1.25-1.45	0.2-0.6	0.12-0.16	5.1-7.3	High---------	0.32			
	53-60	27-50	1.25-1.45	<0.6	0.12-0.18	5.1-7.3	High---------	0.32			
31--------------- Putnam	0-10	12-27	1.30-1.45	0.6-2.0	0.22-0.24	4.5-7.3	Low----------	0.43	3	6	.5-3
	10-17	12-27	1.30-1.50	0.6-2.0	0.20-0.22	4.5-6.5	Low----------	0.43			
	17-41	48-60	1.20-1.40	<0.06	0.09-0.11	3.6-5.5	High---------	0.32			
	41-54	35-48	1.25-1.45	0.06-0.2	0.12-0.16	3.6-5.5	High---------	0.43			
	54-60	27-35	1.30-1.50	0.06-0.2	0.14-0.18	5.1-6.0	Moderate-----	0.43			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
34B-------------- Grundy	0-16	12-27	1.35-1.50	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.37	3	6	2-4
	16-36	40-50	1.30-1.40	0.06-0.2	0.11-0.13	5.1-7.3	High---------	0.37			
	36-60	28-35	1.35-1.40	0.06-0.2	0.18-0.20	5.6-7.3	High---------	0.37			
42--------------- Bremer	0-8	25-30	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7	5-7
	8-46	35-42	1.30-1.40	0.2-0.6	0.15-0.17	5.6-6.5	High---------	0.28			
	46-60	32-38	1.40-1.45	0.2-0.6	0.18-0.20	5.6-6.5	High---------	0.28			
45A-------------- Moniteau	0-15	18-27	1.20-1.40	0.6-2.0	0.21-0.23	5.1-7.3	Low----------	0.43	3	6	1-2
	15-49	27-35	1.30-1.50	0.2-0.6	0.18-0.20	4.5-6.0	Moderate-----	0.43			
	49-60	18-30	1.25-1.45	0.2-0.6	0.20-0.22	4.5-6.5	Low----------	0.43			
51--------------- Wilbur	0-7	10-17	1.30-1.45	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	0.37	5	5	1-3
	7-60	10-17	1.30-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.37			
53--------------- Chequest	0-9	30-35	1.30-1.35	0.2-0.6	0.18-0.20	5.6-7.3	High---------	0.28	5	7	3-4
	9-60	35-42	1.35-1.45	0.2-0.6	0.14-0.18	5.1-6.0	High---------	0.43			
55--------------- Piopolis	0-10	27-35	1.20-1.40	0.06-0.2	0.21-0.23	5.1-6.5	Moderate-----	0.43	4	7	1-3
	10-60	27-35	1.40-1.60	0.06-0.2	0.18-0.20	4.5-5.5	Moderate-----	0.43			
60E, 60F--------- Bethesda	0-5	18-27	1.40-1.55	0.6-2.0	0.10-0.16	3.6-5.5	Low----------	0.32	5	6	<.5
	5-60	18-35	1.60-1.90	0.2-0.6	0.04-0.10	3.6-5.5	Low----------	0.32			
62C, 62D--------- Schuline	0-10	20-35	1.30-1.60	0.6-2.0	0.18-0.21	5.6-8.4	Moderate-----	0.37	5	5	.5-1
	10-60	18-35	1.60-1.80	0.06-0.2	0.08-0.12	5.6-8.4	Moderate-----	0.37			
64*:											
Udorthents.											
Pits.											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
15B2-------------- Calwoods	D	None---------	---	---	1.0-2.5	Perched	Nov-May	>60	---	High------	High------	High.
16C2-------------- Lagonda	C	None---------	---	---	1.5-3.0	Perched	Nov-May	>60	---	High------	High------	Low.
18C2-------------- Gorin	C	None---------	---	---	2.0-4.0	Perched	Nov-May	>60	---	High------	High------	Moderate.
19E2-------------- Gosport	C	None---------	---	---	>6.0	---	---	20-40	Soft	Moderate	High------	High.
23C2, 23E2-------- Keswick	C	None---------	---	---	1.0-3.0	Perched	Nov-May	>60	---	High------	High------	Moderate.
24E*:												
Norris Variant---	B	None---------	---	---	>6.0	---	---	8-20	Soft	Moderate	Low-------	Moderate.
Gosport----------	C	None---------	---	---	>6.0	---	---	20-40	Soft	Moderate	High------	High.
26B2-------------- Leonard	D	None---------	---	---	0.5-2.0	Perched	Nov-May	>60	---	High------	High------	Moderate.
27E--------------- Lindley	C	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
30B--------------- Mexico	D	None---------	---	---	1.0-2.5	Perched	Nov-May	>60	---	Moderate	High------	Moderate.
31---------------- Putnam	D	None---------	---	---	0.5-1.5	Perched	Nov-May	>60	---	Moderate	High------	High.
34B--------------- Grundy	C	None---------	---	---	1.0-3.0	Perched	Mar-May	>60	---	High------	High------	Moderate.
42---------------- Bremer	C	Rare---------	---	---	1.0-2.0	Apparent	Nov-May	>60	---	High------	Moderate	Moderate.
45A--------------- Moniteau	C/D	Rare---------	---	---	0-1.0	Apparent	Nov-May	>60	---	High------	High------	High.
51---------------- Wilbur	B	Frequent----	Brief-----	Nov-May	1.5-3.0	Apparent	Mar-May	>60	---	High------	Moderate	Moderate.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
53----------------- Chequest	C	Frequent----	Long------	Nov-May	1.0-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
55----------------- Piopolis	C/D	Frequent----	Brief to long.	Nov-May	+.5-3.0	Apparent	Mar-May	>60	---	High-----	High-----	Moderate.
60E, 60F---------- Bethesda	C	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	High.
62C, 62D---------- Schuline	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
64*: Udorthents.												
Pits.												

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

Soil name	Family or higher taxonomic class
Bethesda	Loamy-skeletal, mixed, acid, mesic Typic Udorthents
Bremer	Fine, montmorillonitic, mesic Typic Argiaquolls
Calwoods	Fine, montmorillonitic, mesic Aeric Ochraqualfs
Chequest	Fine, montmorillonitic, mesic Typic Haplaquolls
Gorin	Fine, montmorillonitic, mesic Aquic Hapludalfs
Gosport	Fine, illitic, mesic Typic Dystrochrepts
Grundy	Fine, montmorillonitic, mesic Aquic Argiudolls
Keswick	Fine, montmorillonitic, mesic Aquic Hapludalfs
*Lagonda	Fine, montmorillonitic, mesic Aquic Argiudolls
Leonard	Fine, montmorillonitic, mesic Vertic Ochraqualfs
Lindley	Fine-loamy, mixed, mesic Typic Hapludalfs
Mexico	Fine, montmorillonitic, mesic Udollic Ochraqualfs
Moniteau	Fine-silty, mixed, mesic Typic Ochraqualfs
Norris Variant	Mixed, mesic, shallow Typic Udipsamments
Piopolis	Fine-silty, mixed, acid, mesic Typic Fluvaquents
Putnam	Fine, montmorillonitic, mesic Mollic Albaqualfs
*Schuline	Fine-loamy, mixed (calcareous), mesic Typic Udorthents
Udorthents	Fine-loamy, mixed, nonacid, mesic Udorthents
Wilbur	Coarse-silty, mixed, nonacid, mesic Aquic Udifluvents

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