SOIL SURVEY OF

Columbia County, Wisconsin

United States Department of Agriculture
Soil Conservation Service
in cooperation with
Research Division of the
College of Agriculture and Life Sciences
University of Wisconsin

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in the period 1967–71. Soil names and descriptions were approved in 1972. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1971. This survey was made cooperatively by the Soil Conservation Service and the Research Division of the College of Agriculture and Life Sciences, University of Wisconsin. It is part of the technical assistance furnished to the Columbia County Soil and Water Conservation District.

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

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of lands for farming, industry, and recreation.

Locating Soils

All the soils of Columbia County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the woodland group, landscape group, wildlife group, and recreation group to which the soil has been assigned.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the descriptions of the capability units and the woodland groups.

Foresters and others can refer to the section "Soils and Woodland," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Soils and Wildlife."

Community planners and others can read about soil properties that affect the choice of sites for recreation areas in the section "Soils and Recreation."

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in Columbia County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given in the section "Additional Facts About Columbia County."

Cover: Well managed farm area in Columbia County.

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SOIL SURVEY OF COLUMBIA COUNTY, WISCONSIN

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE RESEARCH DIVISION OF THE COLLEGE OF AGRICULTURE AND LIFE SCIENCES, UNIVERSITY OF WISCONSIN

COLUMBIA COUNTY is in the south-central part of Wisconsin (fig. 1). It is bounded on the north by Adams, Marquette, and Green Lake Counties, on the east by Dodge County, on the south by Dane County, and on the west by the Wisconsin River and Sauk County. The county is about 39 miles from east and west and 25 miles from north and south. It has a total land area of 497,920 acres. Lake Wisconsin is the largest lake in the county and the 17th largest lake in the State. It occupies about 5,328 acres.

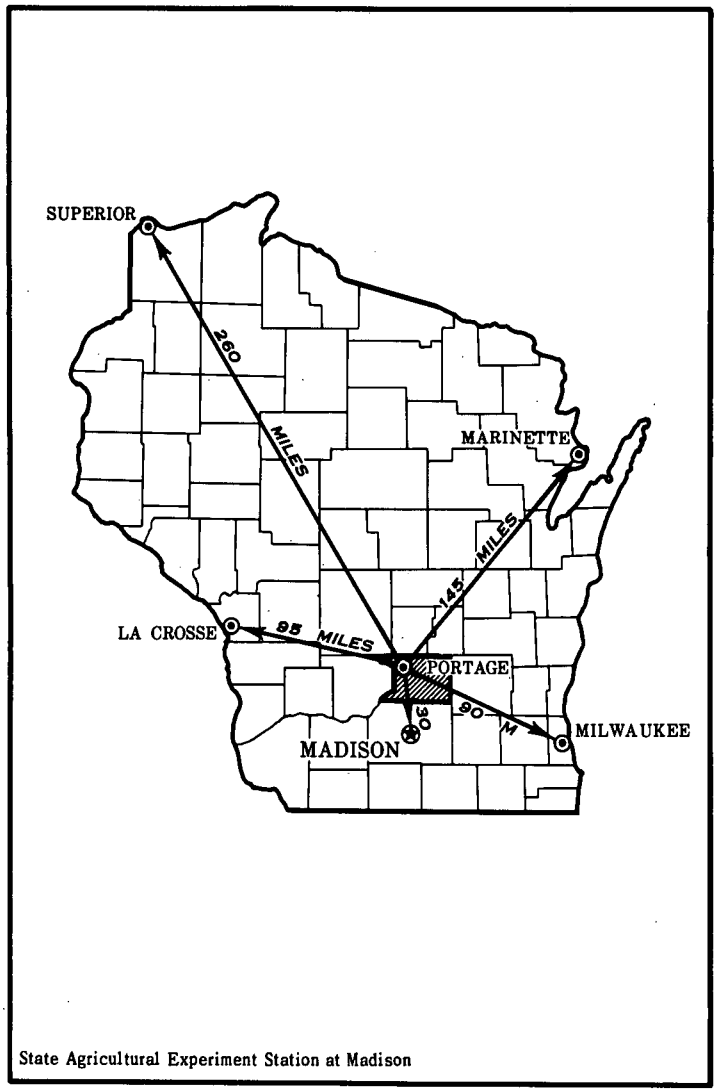

Figure 1.—Location of Columbia County in Wisconsin.

Columbia County has 4 cities, 10 villages, and 21 civil townships. Portage, the largest city and county seat, has a population of about 8,000.

Columbia County has excellent highway connections. Combined Interstate Highways 90 and 94 extend in a north-south direction through the western part of the county. Paralleling the combined interstates is United States Highway 51, one of the major north-south routes in the State. United States Highway 16 traverses the county diagonally from southeast to northwest. A number of other State highways traverse the county, including highways 60, 22, 33, 44, 127, 146, and 78. The county is also accessible by rail, bus, and air.

The original vegetation throughout most of the county was dense hardwood forest (*19*).[1] A large area in the southern part of the county was prairie, the largest of which is the Arlington Prairie. Prairie grass was also the original plant cover in several areas in the eastern part of the county.

The population has gradually increased since the county was established in 1846. Four years after the county was established, the population was 9,565. In 1910 the population was about 31,000, and in 1970, according to the Bureau of the Census, the population was 40,150. About half of the population is classified as urban.

Farming is important in Columbia County and is still the leading occupation. The county has some of the best farm acreages in the State and is one of the leading vegetable producers. Although dairying is the main enterprise, cash grain and vegetable farms are increasing along with the raising and feeding of beef cattle and swine. Harvested cropland, by far the largest use of farmland in the county, amounts to about 275,000 acres. Corn, small grain, and forage crops are grown extensively. A large acreage is cropped to sweet corn and peas, most of which are processed in the local canneries. In 1971, Columbia County ranked first in the State in the production of sweet corn and third in peas. The potential is good for increased productivity through irrigation. An estimated 50,000 acres is suitable for irrigation. Only about 350 acres is now irrigated.

[1] Italic numbers in parentheses refer to Literature Cited, p. 153.

About 120,000 acres in the county is woodland. The largest tracts are in the northwestern part, but smaller tracts are scattered throughout the survey area. In addition to supplying wood products, the wooded tracts are also highly desirable as homesites and recreational areas.

Manufacturing is about even with farming as a source of employment for residents. It is fairly well diversified, and food crops are especially important. Other leading industries are metal working, textiles, apparel, leather goods, and wood products.

Nearly all of the county lies within the glaciated part of Wisconsin. The topography is highly variable. The glaciers formed recessional moraines, drumlins, eskers, ground moraines, outwash plains and terraces, flood plains, glacial lake basins, bedrock ridges, and swamps.

In the far western part of the county is part of one of the most interesting physical features in the State of Wisconsin—the Baraboo Range. This range, which is principally quartzite, rises 400 to 800 feet above the surrounding county. The highest elevations are about 1,400 feet above sea level. The range was once a mountain, in the midst of an extensive plain.

Soils in the survey area formed mainly in glacial drift, but in the eastern and southern part of the county the drift is covered with eolian silty sediment. These silty areas are the major crop-producing areas in the county. A large part of this silty area was formerly under prairie grasses. The soils in the northern and south-central parts of the county formed mainly in stony and bouldery glacial till. Removing stones from the fields before tillage is a yearly practice.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Columbia County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Boyer and Plano, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Boyer loamy sand, 0 to 2 percent slopes, is one of several phases within the Boyer series.

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

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some kind that have been seen within an area that is dominantly of a recognized soil phase.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names, such as Rock land or Marsh.

While a soil survey is in progress, soil scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kind of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants, and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this to the slow permeability of the soil or to its high water table. They see that streets, road pavements, and foundations for houses are cracked on a named kind of soil and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their

studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Columbia County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in plannning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The 11 soil associations in Columbia County are described on the following pages.

1. Plano-Griswold-Saybrook Association

Well drained and moderately well drained silty soils that have a silty or loamy subsoil; underlain by sandy loam glacial till

This association is on glaciated uplands where the soils formed in loess and the underlying glacial till. The landscape is one of long low drumlins and ground moraines characterized by long slopes, swells, swales, and some broad depressions. Moderately steep, glaciated limestone ridges of higher topography parallel the larger drainageways.

This association makes up about 16 percent of the county. It is about 50 percent Plano soils, 14 percent Griswold soils, 10 percent Saybrook soils, and 26 percent soils of minor extent.

Plano soils, on swells, are mostly gently sloping and are well drained or moderately well drained. Typically the surface layer is silt loam, and the subsoil is mostly heavy silt loam. Calcareous sandy loam till is at a depth of more than 60 inches.

Griswold soils, on the crests of drumlins, are mostly gently sloping and sloping and are well drained. Typically the surface layer is silt loam, and the subsoil is mostly sandy clay loam. Calcareous sandy loam till is at a depth of about 38 inches.

Saybrook soils, on small rises and drumlins, are mostly gently sloping and sloping and are well drained. Typically, the surface layer is silt loam, and the subsoil is silty clay loam and loam. Calcareous sandy loam till is at a depth of 38 inches.

Less extensive in this association are Channahon, Joy, Ringwood, Ripon, and Troxel soils. Channahon and Ripon soils are along limestone ridges. Joy soils are on terraces along drainageways and in depressions. Ringwood soils are on drumlins. Troxel soils are in areas that receive sediments from adjoining soils.

This association is well suited to crops. The soils have a thick surface layer high in content of organic matter, and most have high fertility and available water capacity. The main concern in management is controlling water erosion. Improving drainage is a concern in some low-lying areas.

This association is used intensively for crops, mainly corn. Steeper areas are in permanent pasture. The main enterprises are dairying, feeding beef cattle, raising hogs, and growing cash crops. The trend is toward fewer dairy farms and more cash grain and vegetable farms. An increasing acreage is used for sweet corn, peas, and beans. The limestone ridges are a source of crushed limestone for roadbuilding.

2. St. Charles-Ossian-Dodge Association

Well drained, moderately well drained, and poorly drained silty soils that have a silty subsoil; underlain by sandy loam glacial till or silty sediment

This association is mostly a repeating pattern of silt-capped glaciated uplands, mainly drumlins, and wet valleys. This pattern is most distinct near the town of Columbus. The drumlins, several miles long, are northeast-southwest oriented. The landscape ranges from sharply crested drumlins and broad or narrow valleys to broad, low drumlins separated by ground moraines of swells and low-lying areas. Glaciated limestone ridges occupy elevation breaks to low-lying areas. Near the town of Lodi, islands of bedrock covered with silty-capped glacial till rise several hundred feet above the valley floor.

This association makes up about 15 percent of the county. It is about 25 percent St. Charles soils, 16 percent Ossian soils, 12 percent Dodge soils, and 47 percent soils of minor extent.

St. Charles soils, on the sides of drumlins and swells of ground moraines, are mostly gently sloping and sloping and are well drained or moderately well drained. Typically the surface layer is silt loam, and the subsoil is mostly silty clay loam. Calcareous sandy loam till is at a depth of about 58 inches.

Ossian soils, on valley floors along drainageways, are mostly nearly level and are poorly drained. Typically the surface layer is silt loam, and the subsoil is mostly light silty clay loam. Silt loam is at a depth of about 33 inches.

Dodge soils, on the sides of drumlins and swells of ground moraines, are mostly gently sloping and sloping and are well drained. Typically the surface layer is silt loam, and the subsoil is mostly silty clay loam. Calcareous sandy loam till is at a depth of about 39 inches.

Less extensive in this association are Atterberry, Channahon, Knowles, Lapeer, McHenry, and Wacousta soils. Atterberry soils are on valley terraces. Channahon and Knowles soils are along limestone ridges.

Lapeer and McHenry soils are on drumlins. Wacousta soils are in swales where water ponds for long periods.

This association is well suited to crops. Most of the major soils have high fertility and available water capacity. The main concerns in management are controlling water erosion and improving drainage. Water is likely to pond in the lowlands in spring and after a heavy rainfall.

This association is used intensively for crops, mainly corn and forage plants. Steeper areas are in permanent pasture or woodland. Small woodlots are common. The limestone ridges are a source of crushed limestone for roadbuilding. The main enterprises are dairying, feeding beef cattle, and growing cash crops. The trend is toward fewer dairy farms and more cash grain and vegetable farms. An increasing acreage is used for sweet corn, peas, and beans.

3. Mt. Carroll-Seaton-Dresden Association

Well drained and moderately well drained silty and loamy soils that have a silty or loamy subsoil; underlain by stratified silt and sand, silty sediment, or stratified sand and gravel

This association is on outwash plains and on high terraces and benches adjacent to the Wisconsin River (fig. 2). Most of the terrain has a capping of silt. Till-capped islands of sandstone bedrock adjacent to the southern edge of the Baraboo Bluffs rise several hundred feet above the valley floor. The topography is complex. It is mostly convex mounds and ridges of sand and gravel outwash interspaced with lower areas of silt-capped, stratified silt and sand. In a few broad areas the terrain is gently sloping. Deep silty soils are dominant in the lower areas and along valley sides. Coarser textured outwash soils are dominant north of Lake Wisconsin along the Sauk-Columbia County line.

This association makes up about 5 percent of the county. It is about 20 percent Mt. Carroll soils, 20 percent Seaton soils, 10 percent Dresden soils, and 50 percent soils of minor extent.

Mt. Carroll soils, in valleys and other lower areas, are mostly gently sloping and sloping and are moderately well drained. Typically the surface layer and the upper part of the substratum are silt loam. Stratified silt and sand are at a depth of about 56 inches.

Seaton soils, on valley sides and sides of rises, are mostly undulating and rolling and are well drained. Typically they are silt loam to a depth of more than 60 inches.

Figure 2.—Mt. Carroll and Seaton soils on high terraces along the Wisconsin River.

Dresden soils, on convex mounds and ridges, are mostly rolling and hilly and are well drained. Typically the surface layer is loam, and the subsoil is mostly sandy clay loam. Calcareous stratified sand and gravel are at a depth of about 26 inches.

Less extensive in this association are Lapeer, Military, St. Charles, and Sisson soils. Lapeer soils are mainly on the tops and Military soils are on the sides of the till-capped islands of sandstone bedrock. St. Charles soils are on the sides of rises. Sisson soils are on high terraces and valley sides.

The major soils in this association are well suited to crops. They have medium or high available water capacity and fertility. The main concern in management is controlling water erosion.

The major soils in this association are used intensively for crops. The sandstone ridges, steeper slopes, and areas of highly complex topography are in permanent pasture or woodland. Corn, alfalfa, and oats are the major crops. The main enterprises are dairying, growing cash crops of grain, and raising beef cattle. Dresden soils provide a good source of sand and gravel for roadbuilding. In many areas the soils are seriously limited for onsite sewage disposal.

4. McHenry-Baraboo-St. Charles Association

Well drained and moderately well drained silty soils that have a dominantly silty subsoil; underlain by sandy loam glacial till or quartzite bedrock

This association is on silt-capped glaciated uplands that are underlain by quartzite bedrock. The area is known locally as the Baraboo Bluffs. The bluffs are two bold ridges that run east and west at elevations between 400 and 800 feet higher than the surrounding terrain. The quartzite is exposed in many places, particularly in the sides of gorges. The rough-shaped area between the ridges is undulating to hilly silt-capped glacial till.

This association makes up about 2 percent of the county. It is about 30 percent McHenry soils, 24 percent Baraboo soils, 22 percent St. Charles soils, and 24 percent soils of minor extent.

McHenry soils, on the ridges and in the trough-shaped area, are rolling and hilly and well drained. The surface layer is silt loam. The subsoil is silty clay loam in the upper part and sandy clay loam in the lower part. Calcareous sandy loam till is at a depth of about 45 inches.

Baraboo soils, on the crests and sides of the ridges, are rolling to steep and well drained and moderately well drained. Typically the surface layer is silt loam, and the subsoil is mostly heavy silt loam. Quartzite bedrock is at a depth of about 36 inches.

St. Charles soils, in the trough-shaped area, are undulating and rolling and well drained and moderately well drained. Typically the surface layer is silt loam, and the subsoil is mostly silty clay loam. Calcareous sandy loam till is at a depth of about 58 inches.

Less extensive in this association are Lapeer soils and Rock land. The steep and very steep Lapeer soils are mostly on the ridges. Rock land is on the steeper sides of the ridges.

The major soils in this association have medium or high fertility and available water capacity. They are well suited to crops. The main concern in management is controlling water erosion. Many areas are too steep for cultivation.

The steeper ridges, mainly woodland, provide wildlife habitat. Most of the trough-shaped area is cropped to corn or alfalfa. The hilly soils are in pasture or woodland. The main enterprise is dairying. This association is a good source of quartzite for use as abrasive material. The quartzite bedrock, close to the surface, and the steep, complex topography restrict many uses of this association. Obtaining a good supply of well water out of the underlying quartzite bedrock is difficult.

5. Plainfield-Okee Association

Excessively drained and well-drained sandy soils that have a sandy or loamy subsoil; underlain by sandy sediment or sandy loam glacial till

This association is on gently undulating and rolling till and outwash plains. The landscape is one of sand-capped drumlins separated by lower areas of sandy outwash. In places the sand is actively shifting, and small blowouts are common. Steep sandstone ridges are in some areas.

This association makes up about 8 percent of the county. It is about 50 percent Plainfield soils, 10 percent Okee soils, and 40 percent soils of minor extent.

Plainfield soils, on outwash plains, are mostly gently undulating and rolling and are excessively drained. Typically they are sandy throughout, but about 25 percent of the acreage of Plainfield soils is loamy at a depth of 40 to 60 inches.

Okee soils, on drumlins, are gently undulating and rolling and well drained. Typically the surface layer is loamy fine sand. The subsoil is loamy fine sand in the upper part and mostly sandy clay loam in the lower part. Calcareous sandy loam till is at a depth of about 34 inches.

Less extensive in this association are Boone, Boyer, Lapeer, Oshtemo, and Wyocena soils. Boone soils are on sandstone ridges. Boyer and Oshtemo soils are on the outwash plain. Lapeer and Wyocena soils are on drumlins.

This association is poorly suited to farm crops. The major soils are droughty and subject to blowing. Plainfield soils have low fertility and available water capacity.

A large part of this association is wooded and provides wildlife habitat. Dairying and producing forage are the main enterprises. Pine tree plantations are common, and many Christmas trees are produced in these areas. The trend is towards more reforesting and to feeding beef cattle and hogs. An increasing number of homes are built on this association, probably because the association is of low value for farming and is near population centers.

6. Boyer-Oshtemo-Dresden Association

Well-drained sandy and loamy soils that have a loamy subsoil; underlain by sand or stratified sand and gravel

This association is mainly on outwash plains where the soils are underlain by stratified sand and gravel (fig. 3). Slopes are mostly less than 8 percent. The landscape is one of a few sloping drumlins; common, small, steep-sided depressions; and large gravel pits.

This association makes up about 5 percent of the county. It is about 40 percent Boyer soils, 20 percent Oshtemo soils, 10 percent Dresden soils, and 30 percent soils of minor extent.

Boyer soils are mostly undulating. Typically the surface layer is loamy sand, and the subsoil is sandy loam. Calcareous sand and gravel are at a depth of about 32 inches.

Oshtemo soils are mostly undulating. Typically the surface layer is loamy sand, and the subsoil is light sandy loam. Calcareous sand and some gravel are at a depth of about 46 inches.

Dresden soils are mostly undulating. Typically the surface layer is loam, and the subsoil is sandy clay loam. Calcareous sand and gravel are at a depth of about 26 inches.

Less extensive in this association are Granby, Morocco, Plainfield, and Wyocena soils. Granby and Morocco soils are along drainageways and in low-lying swales. Plainfield soils are on high terraces of sandy outwash. Wyocena soils are on drumlins.

All but Dresden soils in this association are limited for growing crops by low fertility and low available water capacity. In some areas the soils are also subject to blowing.

The main enterprise in this association is dairying. Corn, alfalfa, and oats are cropped in rotation to support this enterprise. Small woodlots are common, and a large acreage is perennial pasture. An increasing acreage is used for cucumbers, pumpkins, melons, strawberries, and tomatoes. The soils are well suited to these specialty crops and have good potential for irrigation. This association is a major source of sand and gravel.

7. Oshtemo-Plainfield-Briggsville Association

Excessively drained to moderately well drained sandy and loamy soils that have a sandy, loamy, or clayey subsoil; underlain by sandy sediment, sand and gravel, or clayey sediment

This association is on undulating and sloping outwash plains and gently sloping lake basins. The land-

Figure 3.—Stratified sand and gravel underlies Boyer and Dresden soils, the major source of sand and gravel in the county.

scape is one of ridges and swells of sandy and gravelly outwash and lower areas of clayey sediment in broad valleys, which are extensions of the lake basin into the uplands.

This association makes up about 1 percent of the county. It is about 25 percent Oshtemo soils, 23 percent Plainfield soils, 14 percent Briggsville soils, and 38 percent soils of minor extent.

Oshtemo soils, on north-south oriented ridges of outwash, are mostly sloping and well drained. Typically the surface layer is loamy sand, and the subsoil is sandy loam. Calcareous sand and gravel are at a depth of about 46 inches.

Plainfield soils, on valley sides, are mostly rolling and are excessively drained. They are mostly sandy throughout, but on about 10 percent of the acreage they are loamy below a depth of about 50 inches.

Briggsville soils, in valleys, are gently sloping and are well drained and moderately well drained. Typically the surface layer is loam, and the subsoil is silty clay. Calcareous heavy silty clay loam is at a depth of about 58 inches.

Less extensive in this association are Boyer, Poygan, and Tustin soils, the Briggsville silty subsoil variant, and the Tustin mottled subsoil variant. Boyer soils are on outwash ridges. The Briggsville variant and Tustin soils are on high valley terraces. Poygan soils are along drainageways. The Tustin variant is on low terraces along drainageways.

The soils on the outwash ridges are poorly suited to crops. They have low fertility and available water capacity. They are also subject to soil blowing. The Briggsville soils in the valleys are well suited to crops. They have high fertility and available water capacity.

The outwash ridges in this association are wooded or pastured, and the valleys are cropped intensively to corn or alfalfa. Dairying is the main enterprise. Most soils in the county that have a clayey subsoil and substratum are in this association.

8. Lapeer-Wyocena Association

Well-drained loamy and sandy soils that have a loamy subsoil; underlain by sandy loam or loamy sand glacial till

This association is on glaciated uplands. The landscape is one of ground moraines characterized by swells and swales, drumlins, and glaciated ridges of sandstone bedrock. Slopes are mostly 2 to 12 percent, but range up to 45 percent. The drumlins are east-west oriented. Scattered stones and boulders occur throughout the area.

This association makes up about 22 percent of the county. It is about 40 percent Lapeer soils, 16 percent Wyocena soils, and 44 percent soils of minor extent.

Lapeer soils, on ground moraines and drumlins, are mostly undulating and rolling and are well drained. Typically the surface layer is fine sandy loam, and the subsoil is mostly heavy sandy loam. Calcareous sandy loam till is at a depth of about 31 inches.

Wyocena soils, on ground moraines and drumlins, are mostly undulating to hilly and are well drained. The surface layer is loamy sand, and the subsoil is sandy loam and loamy sand. Calcareous loamy sand till is at a depth of about 37 inches. About 25 percent of the acreage of Wyocena soils is on sandstone ridges and is underlain at a depth of about 50 inches by glauconitic sandstone.

Less extensive in this association are Boyer, Marcellon, Military, Okee, Plainfield, and Rotamer soils. Boyer, Okee, and Plainfield soils are mostly in valleys and along major drainageways. Marcellon soils are along drainageways on foot slopes of till uplands. Military soils are on the crests and sides of sandstone ridges. Rotamer soils are on drumlins.

Crop growth is often limited by the low or medium available water capacity. The major soils have medium fertility, and some are subject to soil blowing. In many places, stones interfere with tillage. Controlling water erosion is also a concern in management.

A large part of this association is cropped in rotation to corn, oats, and alfalfa. The sandstone ridges are mainly in woodland, and small woodlots are common. A large acreage is in permanent pasture. The main enterprises are raising beef cattle and dairying. The trend is towards raising more cash crops, beef cattle, and feeder pigs and to less dairying. Many small areas are used for cucumbers, melons, pumpkins, strawberries, and tomatoes, many of which are sold at roadside markets. For the most part, this association is well suited as sites for dwellings, industrial developments, and road construction.

9. Grellton-Gilford-Friesland Association

Well drained, moderately well drained, and poorly drained loamy soils that have a dominantly loamy subsoil; underlain by sandy loam glacial till, stratified silt and sand, or silty sediment

This association is mostly on nearly level and gently undulating ground moraines where the soils formed mainly in eolian and lacustrine sediments. The landscape is one of broad swells and swales; small billowy areas, mostly of fine sand; and some sloping and moderately steep drumlins of glacial till. In many places, sand has accumulated along fence lines and wooded areas. The drumlins are east-west or northeast-southwest oriented, and some extend for more than a mile. Many are separated by wet valleys.

This association makes up about 10 percent of the county. It is about 18 percent Grellton soils, 15 percent Gilford soils, 12 percent Friesland soils, and 55 percent soils of minor extent.

Grellton soils, on swells, are mostly gently undulating and well drained and moderately well drained. The surface layer is fine sandy loam. The subsoil is fine sandy loam and heavy loam in the upper part and mostly silt loam in the lower part. Calcareous sandy loam till is at a depth of about 55 inches.

Gilford soils, along drainageways and in broad low-lying swales, are nearly level and poorly drained. The surface layer and subsoil are dominantly fine sandy loam. Stratified silt and sand is at a depth of about 32 inches.

Friesland soils, on swells, are mostly gently undulating and well drained and moderately well drained. The

thick, dark-colored surface layer is fine sandy loam. The subsoil is heavy fine sandy loam and heavy loam in the upper part and heavy silt loam in the lower part. A silt loam substratum is at a depth of about 45 inches.

Less extensive in this association are Colwood, Lapeer, Plainfield, Puchyan, Salter, and Sisson soils. Colwood soils are along drainageways. Lapeer soils are on drumlins. Plainfield and Puchyan soils are in billowy areas where sand has accumulated. Salter and Sisson soils are on swells, valley terraces, and valley slopes.

Most of the association is well suited to crops. The major soils have medium or high available water capacity and fertility. The concern in management is improving drainage on the wet soils. Many of the less extensive soils are droughty and subject to blowing.

Most of this association is used intensively for crops, mainly corn, alfalfa, and oats. Small woodlots are common. Many of the steep areas and the undrained, wet areas are used as permanent pasture, woodland, or wildlife habitat. The main enterprises are growing cash crops, raising beef cattle and feeder pigs, and dairying. A large acreage is used for sweet corn for the local canneries. Many of the sandy soils are reforested with pine trees. In general, the soils are not suitable for onsite sewage disposal.

10. Granby-Alluvial Land, Loamy, Wet-Morocco Association

Somewhat poorly drained to very poorly drained sandy soils that have a sandy subsoil and are underlain by sandy sediment; and loamy alluvial land

This association is on nearly level and very gently sloping flood plains and in glacial lake basins. The flood plains along the Wisconsin River, the Baraboo River, and Neenah Creek have a microrelief of several feet created by old stream channels. Remnants of oxbows are along the Baraboo River. The flood plain along the Wisconsin River has long and narrow swales oriented to the flow of the river. The glacial lake basin grades gently north to Neenah Creek, from its highest point just north of the Wisconsin River. Levees (fig. 4) along the Wisconsin River have controlled serious flooding for about 100 years.

This association makes up about 8 percent of the county. It is about 20 percent Granby soils, 17 percent Alluvial land, loamy, wet, 15 percent Morocco soils, and 48 percent soils of minor extent.

Granby soils, in concave positions, are nearly level and poorly drained. They are sandy throughout, and the surface layer is high in content of organic matter.

***Figure 4.*—Levee along the Wisconsin River protects Alluvial land, loamy, from flooding.**

Alluvial land, loamy, wet, which is adjacent to drainageways, is poorly drained and very poorly drained. It is nearly level but is pitted and marked by old stream channels. The surface layer is loamy, and the underlying soil material is layered and variable in texture.

Morocco soils, on convex rises and low terraces, are mostly gently sloping and are somewhat poorly drained. They are sandy throughout.

Less extensive in this association are Colwood, Marshan, Otter, and Gilford soils and Alluvial land, loamy, (fig. 5), Alluvial land, sandy, and Alluvial land, sandy, wet. Colwood, Marshan, and Gilford soils are in low-lying areas. Otter soils are in old stream channels. Alluvial land, loamy, Alluvial land, sandy, and Alluvial land, sandy, wet, are on flood plains.

Available water capacity and fertility are low in Granby and Morocco soils and high in Alluvial land, loamy, wet. Runoff is very slow. In many places, flooding is occasional or frequent. The sandy soils are seasonally droughty and subject to blowing and tend to flow easily when saturated with water. The main concern in management is improving drainage.

Most of this association is used as pasture, wildlife habitat, or woodland. It is poorly suited to crops. Some acreage is used to grow forage crops, vegetable crops, or cash grains. Many deep drainage ditches are in the lake basin between State Highways 16 and 127, and this area has good potential for growing cash crops under irrigation. The soils are severely limited for housing developments and as sites for industries, commercial establishments, and road construction.

11. Houghton-Adrian-Palms Association

Very poorly drained organic soils; underlain in places by sandy or loamy sediment

This association is in broad, low areas of old glacial lake basins and on flood plains along meandering streams. Many of the small lakes in the county are within this association. These organic soils range from less than 1 to more than 6 square miles in size, and where they occur in old lake basins, are roughly circular in shape. On valley floors, they extend for many miles and are about one-half mile wide, but in places, they are wider. Marshy areas of ponded water and cattails occur throughout the association.

This association makes up about 8 percent of the county. It is about 50 percent Houghton soils, 30 per-

Figure 5.—**Alluvial land, loamy, on the Wisconsin River flood plain. If protected from flooding and adequately drained, these broad, nearly level and gently sloping areas have good potential for irrigation.**

cent Adrian soils, 10 percent Palms soils, and 10 percent soils of minor extent.

Houghton soils, generally at the greater distance from adjoining uplands, are nearly level and very poorly drained. They are muck to a depth of 51 inches or more.

Adrian soils, generally near the edge of the organic deposits, are nearly level and very poorly drained. They are muck underlain at a depth of 16 to 51 inches by sand.

Palms soils, also generally near the edge of the organic deposits, are nearly level and very poorly drained. They are muck underlain at a depth of 16 to 51 inches by loamy sediment.

Less extensive in this association are Boots soils, Alluvial land, loamy, wet, and Marsh. Boots soils are only in a lake basin adjacent to Lake Weeting. Alluvial land, loamy, wet, is adjacent to streams. Marsh is adjacent to lakes and in swales within areas of the organic soils.

The major soils in this association have low fertility and high or very high available water capacity. All receive overwash or are subject to flooding. Drainage is needed for crops to grow well. The drained organic soils are subject to subsidence and blowing.

An increasing acreage of this association is used for potatoes, onions, carrots, mint, sod, and other specialty crops. Where drainage is adequate, the soils are well suited to these crops. The undrained areas are used as pasture to a limited extent or as wildlife habitat. They act as storage basins for runoff water that accumulates during wet periods. Most of the wildlife preserves and public hunting and fishing grounds in the county are in this association. The soils are severely limited for housing developments and road construction.

Descriptions of the Soils

This section describes the soil series and mapping units in Columbia County. Each soil series is described in detail, and then, briefly, each mapping unit in that series. Unless specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. Color terms are for moist soil unless otherwise stated. Coarse fragments are reported as a percentage of the total volume of the soil material. The profile described is representative of all mapping units in that series. If the profile of a given mapping unit differs from the one described for the series, these differences are stated in describing the mapping unit, or they are apparent in the name of the mapping unit.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Marsh and Rock land, for example, do not belong to a soil series, but nevertheless, are listed in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit, woodland group, and wildlife group to which the mapping unit has been assigned. The page for the description of each capability unit can be found by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*17*).

Adrian Series

The Adrian series consists of nearly level, very poorly drained organic soils underlain by sand. The organic material is 16 to 50 inches of well-decomposed residue from water-tolerant plants. These soils are in broad glacial lakebeds, in depressions, and along drainageways. The native vegetation was mainly reeds and sedges.

In a representative profile the surface layer is black, very friable muck about 12 inches thick. It is underlain by about 18 inches of black, friable muck. The substratum is gray, mildly alkaline fine and medium sand.

Unless these soils are drained, ground water is at or near the surface throughout most of the year. Permeability is moderately rapid in the organic material and rapid in the mineral substratum. Available water capacity is high. Fertility is low.

In drained areas, Adrian soils are cropped intensively to corn, truck crops, and mint, and some acreage is used for growing sod for lawns. Undrained areas are suited to permanent pasture or wildlife habitat.

Representative profile of Adrian muck (0 to 2 percent slopes) 6 feet west and 174 feet south of the northeast corner of NW¼ sec. 21, T. 13 N., R. 11 E.

Oa1—0 to 12 inches, black (N 2/0) sapric material; about 7 percent fiber, 1 percent rubbed; moderate, fine, subangular blocky structure; very friable; primarily herbaceous fibers; slightly acid (pH 6.2 in H_2O); gradual, wavy boundary.

Oa2—12 to 30 inches, black (N 2/0) sapric material; about 14 percent fiber, 2 percent rubbed; moderate, medium, subangular blocky structure; friable; primarily herbaceous fibers; approximately 2 percent mineral material; slightly acid (pH 6.5 in H_2O); abrupt, wavy boundary.

IIC—30 to 60 inches, gray (10YR 6/1) fine and medium sand; single grained; loose; mildly alkaline.

The organic soil ranges from 16 to 50 inches in thickness. It is primarily herbaceous, but in some places contains woody fragments. It is black, dark reddish brown, or very dark brown. It is generally muck, but in places contains thin layers of peat. The C horizon is typically fine and medium sand, but in some places it is loamy sand.

Adrian soils are near Boots, Houghton, and Palms soils. They formed in shallower deposits of organic material than Boots and Houghton soils. Unlike Palms soils, which have a loamy substratum, they have a sandy substratum.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Acres	Percent
Adrian muck	14,700	3.0
Alluvial land, sandy	1,250	.3
Alluvial land, sandy, wet	3,800	.8
Alluvial land, loamy	4,150	.8
Alluvial land, loamy, wet	7,600	1.5
Atterberry silt loam, 0 to 2 percent slopes	2,100	.4
Atterberry silt loam, 2 to 6 percent slopes	3,800	.8
Baraboo silt loam, 2 to 6 percent slopes, eroded	245	(1)
Baraboo silt loam, 6 to 12 percent slopes, eroded	680	.1
Baraboo silt loam, 12 to 20 percent slopes	980	.2
Baraboo silt loam, 20 to 30 percent slopes	520	.1
Barry loam, 0 to 3 percent slopes	1,750	.4
Boone loamy fine sand, 6 to 12 percent slopes	460	.1
Boone loamy fine sand, 12 to 45 percent slopes	1,100	.2
Boots muck	1,350	.3
Boyer loamy sand, 0 to 2 percent slopes	1,300	.3
Boyer loamy sand, 2 to 6 percent slopes	8,200	1.6
Boyer loamy sand, 6 to 12 percent slopes, eroded	2,700	.5
Boyer loamy sand, 12 to 30 percent slopes, eroded	1,100	.2
Boyer fine sandy loam, 0 to 2 percent slopes	640	.1
Boyer fine sandy loam, 2 to 6 percent slopes	1,200	.2
Briggsville loam, 2 to 8 percent slopes	720	.1
Briggsville silt loam, silty subsoil variant, 1 to 6 percent slopes, eroded	1,050	.2
Channahon silt loam, 2 to 6 percent slopes	750	.2
Channahon silt loam, 6 to 12 percent slopes, eroded	2,050	.4
Channahon silt loam, 12 to 30 percent slopes, eroded	3,200	.6
Chelsea loamy fine sand, 1 to 6 percent slopes	1,200	.2
Chelsea loamy fine sand, 6 to 12 percent slopes	620	.1
Colwood fine sandy loam, 0 to 3 percent slopes	8,000	1.6
Dodge silt loam, 2 to 6 percent slopes, eroded	6,200	1.2
Dodge silt loam, 6 to 12 percent slopes, eroded	3,100	.6
Dodge silt loam, 12 to 20 percent slopes, eroded	530	.1
Dresden loam, 1 to 6 percent slopes	4,000	.8
Dresden loam, 6 to 12 percent slopes, eroded	2,200	.4
Dresden loam, 12 to 20 percent slopes, eroded	1,100	.2
Friesland fine sandy loam, 1 to 6 percent slopes	7,100	1.4
Gilford fine sandy loam, stratified substratum, 0 to 3 percent slopes	11,600	2.3
Granby loamy sand	12,700	2.6
Grellton fine sandy loam, 1 to 6 percent slopes	7,400	1.5
Grellton fine sandy loam, 6 to 12 percent slopes, eroded	1,850	.4
Grellton fine sandy loam, mottled subsoil variant, 0 to 4 percent slopes	1,500	.3
Griswold silt loam, 2 to 6 percent slopes, eroded	6,500	1.3
Griswold silt loam, 6 to 12 percent slopes, eroded	4,600	.9
Griswold silt loam, 12 to 20 percent slopes, eroded	1,250	.3
Houghton muck	21,750	4.4
Joy silt loam, 0 to 4 percent slopes	5,100	1.0
Kibbie fine sandy loam, 0 to 4 percent slopes	2,750	.6
Knowles silt loam, 2 to 6 percent slopes	1,000	.2
Knowles silt loam, 6 to 12 percent slopes, eroded	960	.2
Knowles silt loam, 12 to 20 percent slopes, eroded	400	.1
Lapeer fine sandy loam, 2 to 6 percent slopes	26,250	5.3
Lapeer fine sandy loam, 6 to 12 percent slopes, eroded	16,700	3.4
Lapeer fine sandy loam, 12 to 20 percent slopes, eroded	7,800	1.6
Lapeer fine sandy loam, 20 to 30 percent slopes, eroded	4,650	.9
Lorenzo loam, 2 to 6 percent slopes	510	.1
Lorenzo loam, 6 to 12 percent slopes, eroded	800	.2
Lorenzo loam, 12 to 20 percent slopes, eroded	392	.1
Marcellon loam, 1 to 6 percent slopes	2,800	.6
Marsh	2,750	.6
Marshan loam	3,700	.7
McHenry silt loam, 2 to 6 percent slopes, eroded	2,600	.5
McHenry silt loam, 6 to 12 percent slopes, eroded	5,200	1.0
McHenry silt loam, 12 to 20 percent slopes, eroded	2,250	.5
Military fine sandy loam, 2 to 6 percent slopes	2,000	.4
Military fine sandy loam, 6 to 12 percent slopes, eroded	1,450	.3
Military fine sandy loam, 12 to 20 percent slopes, eroded	1,650	.3
Morocco loamy sand, 0 to 3 percent slopes	6,500	1.3
Mt. Carroll silt loam, 12 to 20 percent slopes, eroded	421	.1
Mt. Carroll silt loam, benches, 0 to 2 percent slopes	415	.1
Mt. Carroll silt loam, benches, 2 to 6 percent slopes	3,300	.7
Mt. Carroll silt loam, benches, 6 to 12 percent slopes, eroded	1,400	.3
Northfield sandy loam, 2 to 6 percent slopes	234	(1)
Northfield sandy loam, 6 to 12 percent slopes	249	.1
Northfield sandy loam, 12 to 30 percent slopes	720	.1
Okee loamy fine sand, 2 to 6 percent slopes	5,000	1.0
Okee loamy fine sand, 6 to 12 percent slopes	2,600	.5
Oshtemo loamy sand, 0 to 2 percent slopes	510	.1
Oshtemo loamy sand, 2 to 6 percent slopes	6,000	1.2
Oshtemo loamy sand, 6 to 12 percent slopes, eroded	1,700	.3
Oshtemo loamy sand, 12 to 20 percent slopes, eroded	437	.1
Ossian silt loam, 0 to 3 percent slopes	15,100	3.0
Otter silt loam	5,000	1.0
Palms muck	5,300	1.1
Plainfield sand, 2 to 12 percent slopes, eroded	650	.1
Plainfield loamy fine sand, 0 to 2 percent slopes	1,750	.4
Plainfield loamy fine sand, 2 to 6 percent slopes	9,800	2.0
Plainfield loamy fine sand, 6 to 12 percent slopes	5,850	1.2
Plainfield loamy fine sand, 12 to 25 percent slopes	2,200	.4
Plainfield loamy fine sand, loamy substratum, 2 to 6 percent slopes	6,500	1.3
Plainfield loamy fine sand, loamy substratum, 6 to 12 percent slopes	1,650	.3
Plainfield loamy fine sand, loamy substratum, 12 to 25 percent slopes	720	.1
Plano silt loam, 0 to 2 percent slopes	8,900	1.8
Plano silt loam, 2 to 6 percent slopes	32,000	6.4
Plano silt loam, 6 to 12 percent slopes, eroded	2,500	.5

TABLE 1.—*Approximate acreage and proportionate extent of the soils*—Continued

Soil	Acres	Percent	Soil	Acres	Percent
Poygan silt loam, 0 to 3 percent slopes	1,100	.2	Seaton silt loam, 6 to 12 percent slopes, eroded	1,950	.4
Puchyan loamy fine sand, 2 to 6 percent slopes	3,200	.6	Seaton silt loam, 12 to 20 percent slopes, eroded	610	.1
Puchyan loamy fine sand, 6 to 12 percent slopes	520	.1	Sisson fine sandy loam, 0 to 2 percent slopes	510	.1
Ringwood silt loam, 1 to 6 percent slopes, eroded	2,550	.5	Sisson fine sandy loam, 2 to 6 percent slopes	2,900	.6
Ringwood silt loam, 6 to 12 percent slopes, eroded	2,050	.4	Sisson fine sandy loam, 6 to 12 percent slopes, eroded	1,250	.2
Ripon silt loam, 2 to 6 percent slopes	730	.1	Sisson fine sandy loam, 12 to 20 percent slopes, eroded	830	.2
Ripon silt loam, 6 to 12 percent slopes, eroded	690	.1	Sisson fine sandy loam, 20 to 30 percent slopes	330	.1
Rock land	2,850	.6	Sparta loamy fine sand, 1 to 6 percent slopes	580	.1
Rodman gravelly loam, 2 to 12 percent slopes	417	.1	Troxel silt loam, 0 to 3 percent slopes	3,750	.8
Rodman gravelly loam, 12 to 20 percent slopes	336	.1	Tustin loamy fine sand, 2 to 6 percent slopes	660	.1
Rodman gravelly loam, 20 to 45 percent slopes	610	.1	Tustin loamy fine sand, mottled subsoil variant, 0 to 4 percent slopes	451	.1
Rotamer loam, 2 to 6 percent slopes	404	.1	Wacousta mucky silt loam	1,600	.3
Rotamer loam, 6 to 12 percent slopes, eroded	900	.2	Wallkill silt loam	520	.1
Rotamer loam, 12 to 20 percent slopes, eroded	830	.2	Wasepi fine sandy loam, 0 to 3 percent slopes	1,150	.2
Rotamer loam, 20 to 30 percent slopes, eroded	452	.1	Winneshiek fine sandy loam, 2 to 6 percent slopes	1,100	.2
St. Charles silt loam, 0 to 2 percent slopes	1,300	.3	Winneshiek fine sandy loam, 6 to 12 percent slopes, eroded	840	.2
St. Charles silt loam, 2 to 6 percent slopes, eroded	16,100	3.2	Wyocena loamy sand, 2 to 6 percent slopes	4,200	.8
St. Charles silt loam, 6 to 12 percent slopes, eroded	6,800	1.4	Wyocena loamy sand, 6 to 12 percent slopes, eroded	2,550	.5
St. Charles silt loam, 12 to 20 percent slopes, eroded	1,260	.3	Wyocena loamy sand, 12 to 20 percent slopes, eroded	2,000	.4
St. Charles silt loam, 20 to 30 percent slopes	880	.2	Wyocena loamy sand, 20 to 45 percent slopes	1,950	.4
Salter fine sandy loam, 0 to 2 percent slopes	840	.2	Wyocena sandy loam, 2 to 6 percent slopes	3,050	.6
Salter fine sandy loam, 2 to 6 percent slopes	2,450	.5	Wyocena sandy loam, 6 to 12 percent slopes, eroded	2,700	.5
Salter fine sandy loam, 6 to 12 percent slopes, eroded	1,100	.2	Wyocena sandy loam, 12 to 20 percent slopes, eroded	1,150	.2
Salter fine sandy loam, 12 to 20 percent slopes, eroded	341	.1	Wyocena fine sandy loam, sandstone substratum, 2 to 6 percent slopes	1,800	.4
Salter fine sandy loam, dark surface variant, 1 to 6 percent slopes	1,550	.3	Wyocena fine sandy loam, sandstone substratum, 6 to 12 percent slopes, eroded	880	.2
Sandy land	440	.1	Wyocena fine sandy loam, sandstone substratum, 12 to 20 percent slopes, eroded	494	.1
Saybrook silt loam, 2 to 6 percent slopes, eroded	5,400	1.1	Wyocena fine sandy loam, sandstone substratum, 20 to 45 percent slopes	1,050	.2
Saybrook silt loam, 6 to 12 percent slopes, eroded	2,400	.5	Yahara fine sandy loam, 0 to 4 percent slopes	3,800	.8
Saybrook silt loam, 12 to 20 percent slopes, eroded	850	.2	Gravel pits	840	.2
Seaton silt loam, 0 to 2 percent slopes	378	.1	Quarries	284	.1
Seaton silt loam, 2 to 6 percent slopes, eroded	2,600	.5	Total	497,920	100.0

[1] Less than 0.05 percent of the county.

Adrian muck (0 to 2 percent slopes) (Ad).—This soil occurs as old glacial lakebeds, large areas in depressions, and broad level valley floors of major streams. Smaller areas are also in depressions and in pockets along drainageways. Some areas in large depressions are long and narrow and occur near the perimeter of Houghton soils.

Included with this soil in mapping are small areas where the substratum has bands of loamy material, small areas along drainageways where the organic material contains thin strata of mineral soil, and some small areas of Houghton muck and Palms muck. Also included are spots of Marsh, shown by spot symbols on the soil map.

This Adrian muck is subject to ponding in spring and after heavy rains. Runoff is very slow. Along streams the soil is subject to flooding. In drained, cultivated areas soil blowing and subsidence are serious hazards.

The larger areas of this soil are cropped to corn, truck crops, and mint. Some areas are used for growing sod for lawns. Drained areas are suited to crops if fertility is maintained and soil blowing and subsidence are controlled. Undrained areas are used as permanent pasture or wildlife habitat. Capability unit IVw-7; woodland group not classified; wildlife group 6.

Alluvial Land, Sandy

Alluvial land, sandy (Ae) is sandy sediment deposited by streams. It is on flood plains and on the bottoms of narrow valleys throughout the survey area, mainly along the major streams and their tributaries. It is flooded periodically, and the floodwaters leave fresh deposits of sediment as they recede. The layering evident in this material of different size sand particles is the result of repeated deposition. The material has been in place long enough for trees and grasses to grow.

Alluvial land, sandy, is nearly level, but is pitted and marked in places by old stream channels. The surface layer is loamy sand or sand. The underlying material has variable textures of fine, medium, and coarse sand, loamy sand, and sandy loam and, in places, of loam and silt loam. In some areas it is highly stratified.

This land is near Granby and Morocco soils and also near Alluvial land, loamy; Alluvial land, loamy, wet; and Alluvial land, sandy, wet. Included in mapping are small areas of Morocco loamy sand and other small areas of Alluvial land, sandy, wet; Alluvial land, loamy; and Alluvial land, loamy, wet.

Alluvial land, sandy, is moderately well drained to somewhat poorly drained. It is seasonally saturated at a depth of 2 to 5 feet. It is droughty and subject to soil blowing if the plant cover is disturbed. Permeability is generally rapid. Available water capacity and fertility are low. Runoff is slow.

Alluvial land, sandy, is not well suited to crops. It has very severe limitations that restrict the choice of plants and require very careful management. It is suited to limited pasture, woodland, or wildlife habitat. Capability unit IVw-5; woodland group 3s1; wildlife group 7.

Alluvial Land, Sandy, Wet

Alluvial land, sandy, wet (Af) is on nearly level flood plains that are pitted and marked by old stream channels. It is frequently flooded. The surface layer is sandy. The underlying material has variable textures of fine, medium, and coarse sand, loamy sand, and sandy loam, and in places, of loam and silt loam.

This land is near Granby and Morocco soils; Alluvial land, sandy; Alluvial land, loamy; and Alluvial land, loamy, wet. Included in mapping are small areas of Granby loamy sand. Also included are small areas of Alluvial land, loamy, wet. Also included are a few small areas of Marsh, which are indicated by spot symbols on the soil map.

This alluvial land is poorly drained and very poorly drained and has a permanent high water table. It is seasonally droughty and subject to soil blowing if the plant cover is disturbed. Permeability is rapid. Available water capacity and fertility are low. Runoff is very slow.

Alluvial land, sandy, wet, is suited to pasture to a limited extent, and to woodland or wildlife habitat. It is generally not suited to crops. Capability unit IVw-5; woodland group 4w4; wildlife group 5b.

Alluvial Land, Loamy

Alluvial land, loamy (Ag) is a mixture of light-colored and dark-colored loamy sediment deposited by streams. It is on flood plains and on the bottoms of narrow valleys throughout the county, mainly along the major streams and their tributaries. It is flooded periodically, and the floodwaters leave fresh deposits of sediment as they recede. The layering evident in this material is the result of repeated deposition. The matrial has been in place long enough for trees and grasses to grow.

Alluvial land, loamy, is nearly level, but is pitted and marked in places by old stream channels. The surface layer is loamy. The underlying material is generally loamy, but ranges from silt loam to sand. In some areas it is highly stratified.

This alluvial land is near Yahara soils; Alluvial land, loamy, wet; Alluvial land, sandy; and Alluvial land, sandy, wet. Included in mapping are some small areas of Alluvial land, loamy, wet; and Alluvial land, sandy.

Alluvial land, loamy, is moderately well drained to somewhat poorly drained. It is seasonally saturated at a depth of 2 to 5 feet. Permeability is moderate. Available water capacity and fertility are high. Runoff is slow.

If protected from flooding, Alluvial land, loamy, is suited to corn, small grain, grasses, and legumes (fig. 6). Where flooding is frequent and cannot be controlled, it is suited to forage, trees, and wildlife habitat. Capability unit IIw-2; woodland group 3o1; wildlife group 7.

Alluvial Land, Loamy, Wet

Alluvial land, loamy, wet (Ah) is nearly level, but is pitted and marked in places by old stream channels. It is frequently flooded. The surface layer is loamy. The underlying material is layered and ranges from silt loam to sandy loam, but in places contains strata of sand.

This land type is near Granby and Gilford soils; Alluvial land, loamy; Alluvial land, sandy; and Alluvial land, sandy, wet. Included in mapping are small areas of Marsh, which are identified on the soil map by spot symbols. Also included are small areas of Granby loamy sand and Palms muck; Alluvial land, loamy; and Alluvial land, sandy, wet.

This alluvial land is poorly drained and very poorly drained and has a permanent high water table. Permeability is moderate. Available water capacity and fertility are high. Runoff is very slow, and ponding is frequent.

Alluvial land, loamy, wet is suitable as permanent pasture, woodland, and wildlife habitat. It is generally not suitable for crops. Capability unit Vw-14; woodland group 4w5; wildlife group 5b.

Atterberry Series

The Atterberry series consists of somewhat poorly drained silty soils. These soils formed in deep deposits of silty sediment. They occupy terraces, depressions,

Figure 6.—**Alluvial land, loamy, on the right, is protected from flooding and suited to crops. Area on left is frequently flooded and is poorly suited.**

basins, swales, and valley floors of upland drainageways in the till plains. Slopes are 0 to 6 percent. The native vegetation was mixed grasses and deciduous trees.

In a representative profile the surface layer is very dark brown silt loam about 8 inches thick. The subsurface layer is very dark grayish-brown silt loam about 2 inches thick. The subsoil is about 35 inches thick. The upper 2 inches is olive-brown, friable heavy silt loam; the next 8 inches is olive-brown, friable silty clay loam; the next 3 inches is dark grayish-brown, firm, heavy silt loam; the next 15 inches is grayish-brown, firm, heavy silt loam; and the lower 7 inches is grayish-brown, firm silt loam. The substratum is mixed light brownish-gray and light olive-brown, mildly alkaline silt loam.

These soils are saturated to a depth of 1 to 3 feet for significant periods during wet seasons. Permeability is moderate to moderately slow. Available water capacity and fertility are high.

Much of the acreage is cultivated. Corn and vegetables are the crops commonly grown.

Representative profile of Atterberry silt loam, 2 to 6 percent slopes, in a cornfield, 150 feet east and 60 feet north of the southwest corner SE¼NE¼ sec. 20, T. 10 N., R. 12 E.

Ap—0 to 8 inches very dark brown (10YR 2/2) silt loam; weak, fine, subangular blocky structure; friable; common fine roots; mildly alkaline; abrupt, smooth boundary.

A2—8 to 10 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, subangular blocky structure; friable; common fine roots; some very dark brown (10YR 2/2) worm casts in coarse pores; mildly alkaline; abrupt, wavy boundary.

B1t—10 to 12 inches, olive-brown (2.5Y 4/4) heavy silt loam; few, fine, distinct, yellowish-brown (10YR 5/6) mottles and common, fine, distinct, dark grayish-brown (10YR 4/2) mottles; weak, fine, subangular blocky structure; friable; common fine roots; few thin clay films on faces of peds; mildly alkaline; clear, wavy boundary.

B21t—12 to 15 inches, olive-brown (2.5Y 4/4) silty clay loam; few, fine, prominent, black (N 2/0) mottles and common, fine, distinct and prominent, dark grayish-brown (2.5Y 4/2) and yellowish-brown (10YR 5/8) mottles; weak, fine, subangular blocky structure; friable; common fine roots; few thin clay films on faces of peds; mildly alkaline; clear, wavy boundary.

B22t—15 to 20 inches, olive-brown (2.5Y 4/4) silty clay loam; common, fine, distinct and prominent, dark grayish-brown (2.5Y 4/2), yellowish-brown (10YR

5/8), and strong-brown (7.5YR 5/6) mottles; moderate, fine and very fine, subangular blocky structure; friable; common fine roots; many thin clay films on faces of peds; mildly alkaline; clear, wavy boundary.

B23tg—20 to 23 inches, dark grayish-brown (2.5Y 4/2) heavy silt loam; few, fine, prominent, black (N 2/0) mottles, common, fine, prominent, yellowish-red (5YR 4/8) mottles, and many, fine, prominent, yellowish-brown (10YR 5/8) mottles; weak, fine, prismatic structure parting to moderate, fine, subangular blocky; firm; few fine roots; common fine clay films on faces of peds; neutral; clear, wavy boundary.

B24tg—23 to 38 inches, grayish-brown (2.5Y 5/2) heavy silt loam; few, fine, prominent, strong-brown (7.5YR 5/6) mottles, common, fine, prominent, black (N 2/0) mottles, and many, fine, prominent, yellowish-brown (10YR 5/8) mottles; moderate, medium, prismatic structure; firm; few fine roots; continuous thin clay films on vertical faces of prisms; neutral; clear, wavy boundary.

B3tg—38 to 45 inches, grayish-brown (2.5Y 5/2) silt loam; many, medium, distinct, light olive-brown (2.5Y 5/4) mottles; weak, coarse, subangular blocky structure; firm; few fine roots; few thin clay films on faces of peds; mildly alkaline; clear, wavy boundary.

Cg—45 to 60 inches, mixed light brownish-gray (2.5Y 6/2) and light olive-brown (2.5Y 5/4) silt loam; massive; friable; mildly alkaline.

The solum typically ranges from 42 to 60 inches in thickness. It ranges from slightly acid to mildly alkaline in reaction, but in some places it is medium acid. The Ap horizon is very dark brown (10YR 2/2), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2) and is 6 to 9 inches thick. The B1 horizon is silt loam or heavy silt loam. The B2 horizon ranges from dark grayish brown (10YR to 2.5Y 4/2) through light yellowish brown (10YR to 2.5Y 6/4) in color and from about 24 to 35 inches in thickness. It is typically heavy silt loam or silty clay loam, but in some places it is silt loam. The weighted average clay content in the upper 20 inches of the B2 horizon is estimated to range from 25 to 30 percent. Mottles with chroma of 1 or 2 are common or many just below the A horizon. In some places the C horizon contains thin strata of fine or very fine sand.

The Atterberry soils in this survey area are generally less acid, contain less clay in the B horizon, and are browner in the upper part of the B horizon than is defined as the range for the series.

Atterberry soils are in a drainage sequence with the well drained and moderately well drained St. Charles soils and the poorly drained Ossian soils. They contain more organic matter in the A horizon than St. Charles soils, but unlike those soils, they do not have the IIB horizon that formed in sandy loam glacial till or sand and gravel outwash. They generally have a thicker solum and a thinner A horizon than Ossian soils.

Atterberry silt loam, 0 to 2 percent slopes (A+A).—This soil is on low terraces in upland basins and on valley floors of till plains. Areas are irregularly shaped in basins and long and narrow along drainageways in valley floors. They range up to 80 acres in size. The profile is similar to that described as representative of the Atterberry series, but the silt loam subsurface layer and silt loam part of the subsoil are slightly thicker.

Included with this soil in mapping are small areas of Ossian silt loam, 0 to 3 percent slopes, and Joy silt loam, 0 to 4 percent slopes, and a few wet spots, which are indicated by spot symbols on the soil map. Also included are some small areas where the surface layer is loam and small areas where the substratum contains strata of sand or where it is sandy loam glacial till.

Runoff is slow to very slow. There is little or no erosion hazard. Water is likely to pond in spring and after a rainfall and remains ponded for significant periods. The ponded water is hazardous to seedlings. Wetness is the major limitation.

Most of the acreage is cropped to corn or peas. If adequately drained, this soil is well suited to crops. Capability unit IIw–2; woodland group 2w5; wildlife group 5a.

Atterberry silt loam, 2 to 6 percent slopes (A+B).—This soil is on low terraces adjacent to basins and upland drainageways. Areas are long and somewhat narrow. Some range up to 100 acres in size. This soil has the profile described as representative of the Atterberry series.

Included with this soil in mapping are small areas of Ossian silt loam, 0 to 3 percent slopes, and a few wet spots, which are identified on the soil map by spot symbols. Also included are a few small areas where the surface layer is loam, some areas where the substratum contains strata of sand or where it is sandy loam glacial till and a few small areas, on toe slopes of drumlins, where the lower part of the subsoil formed in glacial till.

Runoff is slow. There is little or no erosion hazard where slopes are 2 or 3 percent, but erosion is a hazard where slopes are 4 to 6 percent. Good management is needed. Wetness is the major limitation.

Most of the acreage is cultivated. Corn, small grain, and peas are the chief crops. If adequately drained, this soil is well suited to all crops commonly grown in the survey area. Capability unit IIw-2; woodland group 2w5; wildlife group 5a.

Baraboo Series

The Baraboo series consists of well drained and moderately well drained silty soils that formed in 20 to 40 inches of silty sediment over quartzite bedrock. These soils are on the tops and convex sides of ridges. They contain smooth outcrops of quartzite, which are indicated by spot symbols on the soil map. Slopes are complex and range from 2 to 30 percent. The native vegetation was mixed hardwoods, predominantly oak, hickory, and maple.

In a representative profile the surface layer is very dark gray silt loam about 2 inches thick. The subsurface layer is dark grayish-brown silt loam about 3 inches thick. The subsoil is about 31 inches thick. The upper 8 inches is brown, very friable silt loam; the next 9 inches is dark-brown, friable, heavy silt loam; the next 5 inches is dark yellowish-brown, friable silty clay loam; and the lower 9 inches is dark yellowish-brown, friable, heavy silt loam. The quartzite bedrock is at a depth of 36 inches.

Permeability is moderate. Available water capacity and fertility are medium. Quartzite bedrock at a depth of 20 to 40 inches restricts roots and many uses of these soils.

The gently sloping Baraboo soils are mainly under cultivation. Steeper areas are used for woodland or pasture.

Representative profile of Baraboo silt loam, 6 to 12 percent slopes, eroded, in an uneroded area 275 feet

south and 450 feet west of the northeast corner of SE¼SW¼ sec. 26, T. 12 N., R. 8 E.

A1—0 to 2 inches, very dark gray (10YR 3/1) silt loam; weak, fine, granular structure; very friable; many fine roots; slightly acid; abrupt, smooth boundary.

A2—2 to 5 inches, dark grayish-brown (10YR 4/2) silt loam; weak, medium, platy structure; very friable; common fine roots; slightly acid; clear, wavy boundary.

B1—5 to 13 inches, brown (10YR 5/3) silt loam; weak, very fine, subangular blocky structure; very friable; common fine roots; medium acid; clear, wavy boundary.

B21t—13 to 22 inches, dark-brown (10YR 4/3) heavy silt loam; weak, fine, subangular blocky structure; friable; common fine roots; common thin clay films; medium acid; clear, wavy boundary.

B22t—22 to 27 inches, dark yellowish-brown (10YR 4/4) silty clay loam; few, fine, distinct and prominent, strong-brown (7.5YR 5/6) and yellowish-red (5YR 4/8) mottles; moderate, fine, subangular blocky structure; friable; few fine roots; many thin clay films; about 2 percent fine quartzite gravel; medium acid; clear, wavy boundary.

B23t—27 to 36 inches, dark yellowish-brown (10YR 4/4) heavy silt loam, high in content of fine sand; few, fine, distinct, strong-brown (7.5YR 5/6) mottles; moderate, fine, angular and subangular blocky structure; friable; few fine roots; many moderately thick clay films; about 5 percent quartzite gravel; slightly acid; abrupt, wavy boundary.

IR—36 to 60 inches, quartzite bedrock.

The solum is 20 to 40 inches thick over quartzite bedrock. The lower part is as much as 15 percent quartzite gravel. The A1 horizon ranges from black (10YR 2/1) to dark gray (10YR 4/1) and is 1 to 4 inches thick. Where it occurs, the Ap horizon ranges from very dark grayish brown (10YR 3/2) to grayish brown (10YR 5/2) and is 6 to 9 inches thick. The A2 horizon ranges from dark grayish brown (10YR 4/2) to brown (10YR 5/3) and is 2 to 5 inches thick. The Bt horizon is dark brown (10YR 4/3) or (7.5YR 4/4) or dark yellowish brown (10YR 3/4 to 4/4). In some places, the lower part is not mottled.

Baraboo soils are similar to Knowles and Dodge soils. They have more silt and less sand in the lower part of the B horizon than those soils. In addition, unlike Dodge soils, which have bedrock at an undetermined great depth, they are underlain by bedrock within a depth of 40 inches. Unlike Knowles soils, which are underlain by limestone at a depth of 20 to 40 inches, they are underlain by quartzite.

Baraboo silt loam, 2 to 6 percent slopes, eroded (BaB2).—This soil is on the convex sides and the crests of slight rises on uplands. Areas are irregularly shaped and range from 10 to 30 acres in size. Quartzite stones on the surface are indicated by spot symbols on the soil map. Tillage has mixed the surface layer and subsurface layer and part of the subsoil. This mixed layer is commonly dark grayish brown and about 8 inches thick.

Included with this soil in mapping are a few areas where bedrock is at a depth of less than 20 inches or more than 40 inches, a few nearly level areas, and some areas where the lower few inches of the subsoil is sandy clay loam. Also included are forested areas where little or no erosion has occurred.

Runoff is medium. The erosion hazard is slight where slopes are 2 or 3 percent and moderate where they are 4 to 6 percent.

Most of the acreage is cultivated. Some is wooded. Capability unit IIe–2; woodland group 2o1; wildlife group 1.

Baraboo silt loam, 6 to 12 percent slopes, eroded (BaC2).—This soil is on the convex sides and the crests of rises in the uplands. Areas are irregularly shaped and commonly 30 to 60 acres in size. This soil has the profile described as representative of the series, but in cultivated areas tillage has mixed the upper part of the subsoil and the subsurface layer with the original surface layer and part of the present surface layer has been lost through erosion. Some areas have quartzite stones on the surface. These areas are indicated by spot symbols on the soil map.

Included with this soil in mapping are a few small areas where bedrock is at a depth of less than 20 inches or more than 40 inches and some areas where the lower few inches of the subsoil is sandy clay loam.

Runoff is medium. The erosion hazard is moderate.

Most of the acreage is pastured or wooded. Some is cropped to corn or legumes. Capability unit IIIe–2; woodland group 2o1; wildlife group 1.

Baraboo silt loam, 12 to 20 percent slopes (BaD).—This soil is in large areas along ridges. It has a profile similar to the one described as representative of the series, but depth to bedrock changes within short distances and in many places the lower part of the subsoil is not mottled.

Included with this soil in mapping are small areas of Rock land. Small areas of this soil are underlain by bedrock at a depth of less than 20 inches or more than 40 inches. In some places the lower part of the subsoil formed in loamy glacial till. This soil has some spots of eroded soil.

Runoff is rapid. The erosion hazard is severe.

This soil is poorly suited to cultivated crops. Most of the acreage is forested. Capability unit IVe–2; woodland group 2r2; wildlife group 1.

Baraboo silt loam, 20 to 30 percent slopes (BaE).—This soil is in long areas along ridges and bluffs near Rock land. The areas range up to several hundred acres in size. This soil has a profile similar to the one described as representative of the series, but it is commonly shallower over bedrock and the subsoil is seldom mottled.

Included with this soil in mapping are small areas of Baraboo silt loam, 12 to 20 percent slopes. This soil has a few bedrock escarpments, and these are indicated by spot symbols on the soil map. Some areas of this soil are eroded. In some places, bedrock is at a depth of less than 20 inches.

Runoff is very rapid. The erosion hazard is very severe if the plant cover is removed.

This soil is poorly suited to cultivated crops. Most of the acreage is forested. Capability unit VIe–2; woodland group 2r2; wildlife group 1.

Barry Series

The Barry series consists of poorly drained loamy soils that formed mainly in sandy loam glacial till. These soils are typically along drainageways and in depressions in till plains and moraines. In some places, stones on the surface are common enough to interfere with tillage or to make tillage impractical unless the stones are cleared. In some places, as much as 20 inches

of the upper part of the soil formed in silt. Slopes are 0 to 3 percent. The native vegetation was deciduous forest and water-tolerant grasses.

In a representative profile the surface layer is black loam about 14 inches thick. The subsoil is about 21 inches thick. The upper 7 inches is dark grayish-brown clay loam; the next 4 inches is dark grayish-brown gravelly heavy loam; and the lower 10 inches is grayish-brown gravelly heavy sandy loam. The substratum is grayish-brown, moderately alkaline gravelly sandy loam.

These soils are subject to ponding in spring and after heavy rains. Ground water is at or near the surface throughout most of the year. Permeability is moderate. Available water capacity is medium, and fertility is high.

If drained adequately, Barry soils are used mostly for cultivated crops. Undrained areas are in permanent pasture or woodland.

Representative profile of Barry loam, 0 to 3 percent slopes, 636 feet east and 201 feet south of the northwest corner of SW¼SE¼ sec. 13, T. 11 N., R. 12 E.

Ap—0 to 7 inches, black (10YR 2/1) loam; few, fine, distinct, dark grayish-brown (10YR 4/2) mottles; weak, fine, subangular blocky structure; friable; many fine roots; slightly acid; abrupt, smooth boundary.

A12—7 to 14 inches, black (10YR 2/1) loam; few, fine, distinct and prominent, dark grayish-brown (10YR 4/2) and yellowish-brown (10YR 5/6) mottles; weak, fine and medium, subangular blocky structure; friable; common fine roots; neutral; clear, wavy boundary.

B21tg—14 to 21 inches, dark grayish-brown (10YR 4/2) clay loam; common, fine, prominent, yellowish-brown (10YR 5/6) mottles and many, fine, distinct, very dark brown (10YR 2/2) mottles; moderate, medium, subangular blocky structure; friable; common fine roots; about 8 percent gravel; many thin clay films; mildly alkaline; clear, wavy boundary.

B22tg—21 to 25 inches, dark grayish-brown (10YR 4/2) gravelly heavy loam; common, fine and medium, distinct and prominent, dark-gray (5Y 4/1) and strong-brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; friable; common fine roots; about 20 percent gravel and 1 percent cobblestones; many thin clay films; mildly alkaline; abrupt, wavy boundary.

B3g—25 to 35 inches, grayish-brown (2.5Y 5/2) gravelly heavy sandy loam; many, medium, prominent, yellowish-brown (10YR 5/6 to 5/8) mottles; weak, coarse, subangular blocky structure; friable; few fine roots; about 30 percent gravel and 5 percent cobblestones; mildly alkaline; clear, wavy boundary.

Cg—35 to 60 inches, grayish-brown (2.5Y 5/2) gravelly sandy loam; few, fine, prominent, yellowish-brown (10YR 5/6 to 5/8) mottles; moderate, very fine, platy structure; friable; about 20 percent gravel and 2 percent cobblestones; moderately alkaline; strong efferverscence.

The solum typically ranges from 30 to 40 inches in thickness but in places ranges from 24 to 50 inches. The A horizon is 10 to 15 inches thick. It is black (10YR 2/1), very dark brown (10YR 2/2), or very dark gray (10YR 3/1). The B2g horizon is dark grayish-brown (10YR to 2.5Y 4/2) to light brownish-gray (10YR to 2.5Y 6/2) loam, heavy loam, sandy clay loam, or clay loam.

The Barry soils in this survey area contain more gravel in the B horizon than is defined as the range for the series.

The poorly drained Barry soils are in a drainage sequence with the well-drained Griswold soils and the somewhat poorly drained Marcellon soils. In addition to differing in drainage, they have a surface layer of loam, whereas Griswold soils typically have a surface layer of silt loam.

Barry loam, 0 to 3 percent slopes (BbA).—This soil is typically along drainageways and in depressions in till plains and moraines. Most areas are long and somewhat narrow. Areas typically range from 10 to 50 acres in size.

Included with this soil in mapping are small areas that have a surface layer of silt loam. Also included are small areas that have a substratum of sand and gravel, some small areas that have a surface layer of fine sandy loam, and a few small areas of Colwood fine sandy loam, 0 to 3 percent slopes.

Runoff is very slow to ponded. There is little or no erosion hazard. Wetness is the major limitation.

Most of the acreage has been artificially drained. If drained, this soil is suited to the crops commonly grown in the survey area. Undrained areas are suited to permanent pasture or woodland. In some places, stones on the surface and in the subsoil are numerous enough to interfere with tillage and installation of tile drains. Capability unit IIw–1; woodland group 4w5; wildlife group 5b.

Boone Series

The Boone series consists of excessively drained sandy soils underlain at a depth of about 20 to 45 inches by sandstone bedrock. These soils are on the sides of sandstone ridges. They formed in sandy residuum weathered from sandstone, which is less than 5 percent weatherable minerals. The sand grains are mainly quartz. Small outcrops of bedrock and a few blowouts are indicated by spot symbols on the soil map. Slopes are typically 12 to 45 percent, but range from 6 to 45 percent. The present vegetation is grasses and a sparse growth of oak trees.

In a representative profile the surface layer is black loamy fine sand about 1 inch thick. This is underlain by about 3 inches of dark-brown loamy fine sand. The subsoil is light yellowish-brown fine sand about 18 inches thick. The substratum is light-gray fine sand, about 23 inches thick, that contains weakly cemented pieces of sandstone bedrock. The substratum is underlain at a depth of about 45 inches by weakly cemented sandstone bedrock.

These soils are droughty and susceptible to blowing. Permeability is rapid. Available water capacity and fertility are very low.

Boone soils are poorly suited to many plants and trees.

Representative profile of Boone loamy fine sand, 6 to 12 percent slopes, in a wooded area 330 feet north and 530 feet west of the southeast corner of NE¼ sec. 11, T. 13 N., R. 8 E.

A1—0 to 1 inch, black (10YR 2/1) loamy fine sand; weak, fine, subangular blocky structure; very friable; many fine roots; slightly acid; abrupt, smooth boundary.

AB—1 to 4 inches, dark-brown (10YR 4/3) loamy fine sand; weak, fine, subangular blocky structure; very friable; few fine roots; medium acid; clear, wavy boundary.

B—4 to 22 inches, light yellowish-brown (10YR 6/4) fine sand; single grained; loose; few fine roots; about 1 percent gravel; medium acid; abrupt, smooth boundary.

C1—22 to 45 inches, light-gray (10YR 7/2) fine sand; single grained; loose; about 10 to 15 percent of the horizon occupied by 1- to 4- inch pieces of very weakly cemented sandstone that fall apart upon displacement; slightly acid; clear, wavy boundary.

C2—45 to 60 inches, light-gray (10YR 7/2) weakly cemented sandstone; very thin yellowish-brown (10YR 5/8) striations oriented horizontally; slightly acid.

Sandstone bedrock is at a depth of 20 to 45 inches. The A1 horizon ranges from black (10YR 2/1) to dark grayish brown (10YR 4/2) and is 1 to 3 inches thick. Some soils have an A-C-R horizon sequence. Where it occurs, the B horizon ranges from yellowish brown (10YR 5/4) to yellow (10YR 7/6). The C horizon commonly ranges from light gray (10YR 7/1) to very pale brown (10YR 8/4). The residuum between the base of the A horizon and the sandstone bedrock is fine or medium sand. The sandstone is mainly quartz and is commonly indurated below a depth of 40 inches. In many places, the degree of cementation varies within the same soil.

Boone soils occur with Northfield soils and are similar to Plainfield soils. They contain less clay and fewer weatherable minerals than Northfield soils. They contain more quartz and fewer weatherable minerals than Plainfield soils.

Boone loamy fine sand, 6 to 12 percent slopes (BnC).—This soil is in long, narrow areas at the foot slopes of sandstone ridges, near Plainfield soils. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of Plainfield loamy fine sand, 6 to 12 percent slopes. In a few areas, the bedrock is at a depth of less than 20 inches.

Runoff is medium. The hazard of water erosion is slight.

This soil is poorly suited to crops. Most of the acreage is forested. Capability unit VIs-3; woodland group 4s1; wildlife group 3.

Boone loamy fine sand, 12 to 45 percent slopes (BnE).—This soil is along sandstone ridges in long and narrow areas that are commonly 20 to 40 acres in size. It has a profile similar to that described as representative of the series, but it is shallower over bedrock.

Included with this soil in mapping are small areas of Plainfield loamy fine sand, 12 to 25 percent slopes.

Runoff is medium. The hazard of water erosion is moderate.

This soil is poorly suited to vegetation. It supports a sparse growth of oak trees. Capability unit VIIs-9; woodland group 4s2; wildlife group 3.

Boots Series

The Boots series consists of nearly level, very poorly drained organic soils. These soils formed in deep deposits of partly decomposed residue from water-tolerant plants. They are in old glacial lakebeds. The native vegetation was mainly reeds and sedges.

In a representative profile the surface layer is black muck about 10 inches thick. It is underlain by dark reddish-brown peat, which extends to a depth of 60 inches.

Permeability is moderately rapid. Available water capacity is very high. Fertility is low. Ground water is at or near the surface throughout most of the year.

All the acreage of these soils is in tamarack trees, red-osier, grasses, sedges, reeds, and cattails. This wetland woods provides habitat for wildlife. The tamarack trees are harvested periodically. The soils are suited to crops if cleared and drained.

Representative profile of Boots muck (0 to 2 percent slopes) in a tamarack swamp, 2,280 feet north and 1,059 feet east of the southwest corner of sec 10, T. 13 N., R 7 E.

Oa1—0 to 4 inches, black (5YR 2/1) sapric material; dark reddish-brown (5YR 2/2) rubbed; about 15 percent fiber, 5 percent rubbed; massive; very friable; common roots; primarily herbaceous fibers; neutral (pH 7.0 in H_2O); clear, wavy boundary.

Oa2—4 to 10 inches, dark reddish-brown (5YR 2/2) sapric material, dark reddish-brown (5YR 3/2) rubbed; about 20 percent fiber; 5 percent rubbed; massive; very friable; primarily herbaceous fibers; neutral pH 7.0 in H_2O); clear, wavy boundary.

Oe1—10 to 60 inches, dark reddish-brown (5YR 3/2) hemic material, dark brown (7.5YR 3/2) rubbed; about 70 percent fiber, 15 percent rubbed; weak, platy structure; very friable; primarily herbaceous fibers; neutral (pH 7.0 in H_2O).

The organic material is more than 51 inches thick and is mainly herbaceous but in some places contains woody fragments. The layers are black, dark reddish-brown, very dark brown, or dark brown.

Boots soils are near Adrian and Houghton soils. They are not so decomposed as Adrian and Houghton soils.

Boots muck (0 to 2 percent slopes) (Bo).—This soil is in old glacial lakebeds. Most of the area has several inches of sphagnum moss on the surface, but no decayed moss is evident in the soil profile. A small area of this soil is wooded with black spruce.

Included with this soil in mapping are small spots of Marsh, which are indicated by spot symbols on the soil map, and some small areas of Houghton muck.

This Boots muck is more acid than surrounding soils. It is subject to ponding in spring and after a heavy rain. Runoff is very slow. If the soil is drained and cultivated, soil blowing and subsidence are hazards.

This soil is suited to crops if cleared and drained. The entire acreage is in tamarack trees and water-tolerant plants and provides good wildlife habitat. Capability unit IIIw-9; woodland group not classified; wildlife group 6.

Boyer Series

The Boyer series consists of well-drained loamy and sandy soils underlain at a depth of 24 to 40 inches by calcareous sand and gravel outwash. These soils are on outwash plains, valley trains, and moraines. Some gravel pits and small depressions are indicated by spot symbols on the soil map. Slopes are commonly less than 12 percent, but range up to 30 percent. The native vegetation was deciduous trees.

In a representative profile the surface layer is very dark grayish-brown loamy sand about 7 inches thick. The subsoil is about 25 inches thick. The upper 7 inches is dark-brown, very friable sandy loam; the next 6 inches is dark-brown, friable heavy sandy loam; the

next 7 inches is dark-brown, very friable light loamy sand; and the lower 5 inches is dark yellowish-brown very friable gravelly loamy sand. The substratum is very pale brown, mildly alkaline, stratified sand and gravel.

These soils tend to be droughty. Permeability is moderately rapid. Available water capacity and fertility are low.

Much of the acreage is cultivated. The steeper areas are in pasture or woodland. These soils are a good source of sand and gravel.

Representative profile of Boyer loamy sand, 2 to 6 percent slopes, in a cornfield 69 feet west and 378 feet south of the northeast corner of sec. 4, T. 12 N., R. 10 E.

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) loamy sand; weak, coarse, subangular blocky structure; very friable; common fine roots; mildly alkaline; abrupt, smooth boundary.

B21t—7 to 14 inches, dark-brown (7.5YR 4/4) sandy loam; weak, medium, subangular blocky structure; very friable; common fine roots; many thin clay bridges between mineral grains; about 5 percent gravel; slightly acid; gradual, wavy boundary.

B22t—14 to 20 inches, dark-brown (7.5YR 4/4) heavy sandy loam; weak, medium, subangular blocky structure; friable; common fine roots; few thin clay films on faces of peds; about 14 percent gravel; neutral; clear, wavy boundary.

B31—20 to 27 inches, dark-brown (7.5YR 4/4) light loamy sand; very weak, coarse, subangular blocky structure; very friable; few fine roots; very few thin clay bridges between mineral grains; about 7 percent gravel; neutral; clear, wavy boundary.

B32—27 to 32 inches, dark yellowish-brown (10YR 3/4) gravelly loamy sand; weak, medium, subangular blocky structure; very friable; few fine roots; common thin clay bridges between mineral grains; about 20 percent gravel; mildly alkaline; abrupt, wavy boundary.

IIC—32 to 60 inches, very pale brown (10YR 7/3) stratified sand and gravel; single grained; loose; mildly alkaline; slightly effervescent.

The solum ranges from 24 to 40 inches in thickness and is as much as 25 percent gravel. The Ap horizon ranges from very dark grayish brown (10YR 3/2) to brown (10YR 4/3), and the content of organic matter is estimated to be very low. Where present, the A1 horizon is very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2) and is less than 5 inches thick. The Ap or A1 horizon is loamy sand or fine sandy loam. In places the A2 horizon is brown (10YR 4/3 or 5/3) or yellowish-brown (10YR 5/4) loamy sand or fine sandy loam that is less than 6 inches thick.

The B2t horizon is commonly light sandy loam, sandy loam, or heavy sandy loam but, in some places, as much as 6 inches of the B2t horizon is sandy clay loam. The B3 horizon ranges from dark brown (7.5YR 4/4) to strong brown (7.5YR 5/6), or it is dark brown (7.5YR 3/2) or dark yellowish brown (10YR 3/4). It does not occur in some places. In places, the lower part of the B horizon consists of layers of sandy loam, 1 to 4 inches thick, that are separated by loamy sand. Reaction in the B horizon is commonly medium acid to neutral, but it ranges to mildly alkaline in the lower part. Typically the IIC horizon is stratified sand and gravel, but in places it is mostly sand.

The Boyer soils in this survey area are less acid in the lower part of the B horizon than is defined as the range for the series, and the very dark grayish-brown (10YR 3/2) color in the Ap horizon is outside the defined range for the series.

Boyer soils occur with Oshtemo, Dresden, and Wasepi soils. They have a thinner solum than Oshtemo soils. They have less clay in the B horizon than Dresden soils. They are better drained than Wasepi soils.

Boyer loamy sand, 0 to 2 percent slopes (BpA).—Large, irregularly shaped areas of this soil are on valley floors and on broad outwash plains near Oshtemo soils. The surface is pitted in some places. There are a few gravel pits. This soil has a profile similar to the one described as representative of the series, but the surface layer is about 9 inches thick and in some places it is underlain by a thin subsurface layer of brown loamy sand.

Included with this soil in mapping are small areas of Boyer fine sandy loam, 0 to 2 percent slopes; Oshtemo loamy sand, 0 to 2 percent slopes; and Plainfield loamy fine sand, 0 to 2 percent slopes. Also included are some areas where thin bands of loamy material are in the substratum, areas where the surface layer is thicker and darker colored, and areas where the lower part of the subsoil is seasonally saturated.

This Boyer soil is subject to blowing. Runoff is very slow. The hazard of water erosion is slight.

This soil has excellent potential for growing special crops under irrigation and is a good source of sand and gravel. Most of the acreage is cultivated. Corn, small grain, and hay are commonly grown. The soil is also used for pasture. Capability unit IIIs–4; woodland group 3o1; wildlife group 3.

Boyer loamy sand, 2 to 6 percent slopes (BpB).—Large, irregularly shaped areas of this soil are on undulating outwash plains and on valley sides near Oshtemo soils. Areas range up to several hundred acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Oshtemo loamy sand, 2 to 6 percent slopes; Boyer loamy sand, 0 to 2 percent slopes; Plainfield loamy fine sand, 2 to 6 percent slopes; and Dresden loam, 1 to 6 percent slopes. Also included are a few areas where thin bands of loamy material are at a depth of about 40 to 60 inches and areas where the surface layer is darker colored. In some places, part of the surface layer has been lost through soil blowing.

This Boyer soil is susceptible to blowing if the plant cover is removed. Runoff is slow, and the hazard of water erosion is slight.

This soil has potential for growing special crops under irrigation and is a source of sand and gravel. It is mainly cropped to corn, small grain, or hay. Some is wooded or pastured. Growth of crops is limited by low available water capacity and low fertility. Capability unit IIIs-4; woodland group 3o1; wildlife group 3.

Boyer loamy sand, 6 to 12 percent slopes, eroded (BpC2).—Large, irregularly shaped or long areas of this soil occur on the sides of rises on outwash plains, moraines, or valley sides. Some areas range up to 200 acres in size. The surface layer is commonly dark grayish-brown or dark-brown loamy sand about 5 to 7 inches thick. In some wooded areas, the soil has a surface layer of very dark grayish-brown loamy sand less than 5 inches thick and a subsurface layer of brown loamy sand about 4 inches thick. In some more eroded spots, subsoil material is exposed at the surface.

Included with this soil in mapping are small areas of Oshtemo loamy sand, 6 to 12 percent slopes, eroded; Plainfield loamy fine sand, 6 to 12 percent slopes; and

Wyocena loamy sand, 6 to 12 percent slopes, eroded. Also included are some areas where thin bands of loamy material are at a depth of 40 to 60 inches.

This Boyer soil is susceptible to blowing. The hazard of water erosion is moderate.

This soil is a source of sand and gravel. Much of the acreage is cropped to hay or is pastured or wooded. Row crops are grown in some places. Capability unit IIIe–7; woodland group 3o1; wildlife group 3.

Boyer loamy sand, 12 to 30 percent slopes, eroded (BpD2).—This soil occurs along valley sides and in complex topography on the outwash plain. Areas range up to 60 acres in size. Slopes are short and commonly range from 12 to 20 percent. The surface layer is commonly very dark grayish brown and about 1 to 3 inches thick. The subsurface layer is brown loamy sand about 4 to 6 inches thick.

Included with this soil in mapping are small areas of Oshtemo loamy sand, 12 to 20 percent slopes, eroded; Plainfield loamy fine sand, 12 to 25 percent slopes; and Wyocena loamy sand, 12 to 20 percent slopes, eroded. In a few places, thin bands of loamy material are at a depth of 40 to 60 inches, the upper part of the subsoil is loamy sand, or sandstone bedrock is at a depth of 40 to 60 inches.

This Boyer soil is subject to blowing. Runoff is rapid. The hazard of erosion is severe.

This soil is poorly suited to cultivated crops. It is mainly in pasture or woodland. Capability unit IVe–7; woodland group 3r2; wildlife group 3.

Boyer fine sandy loam, 0 to 2 percent slopes (BrA).—Irregularly shaped areas of this soil occur on valley floors and in concave areas on the outwash plain. Areas are commonly less than 40 acres in size. The surface layer is very dark grayish brown and about 8 to 9 inches thick. A thin layer of sandy clay loam is commonly in the subsoil. Some areas have a subsurface layer of brown fine sandy loam 1 to 4 inches thick.

Included with this soil in mapping are small areas of Boyer loamy sand, 0 to 2 percent slopes. Also included are some areas where the surface layer is darker colored, areas where the subsoil extends to a depth of more than 40 inches, areas where the lower part of the subsoil is seasonally saturated, and areas where thin bands of loamy material are at a depth of 40 to 60 inches.

This soil is less droughty than Boyer loamy sand, 0 to 2 percent slopes. Runoff is slow. The erosion hazard is slight. In many places, the soil receives runoff from adjacent uplands.

This soil has good potential for growing special crops under irrigation and is a good source of sand and gravel. Most of the acreage is cropped to corn. Capability unit IIIs–4; woodland group 3o1; wildlife group 1.

Boyer fine sandy loam, 2 to 6 percent slopes (BrB).—Large, irregularly shaped areas of this soil occur on valley foot slopes and on undulating topography on the outwash plain. In some places, the surface is pitted. The surface layer is very dark grayish brown and about 7 or 8 inches thick. A thin layer of sandy clay loam is commonly in the subsoil. Some areas have a thin layer of fine sandy loam in the upper part of the subsoil.

Included with this soil in mapping are small areas of Boyer fine sandy loam, 0 to 2 percent slopes, and Boyer loamy sand, 2 to 6 percent slopes. Also included are some areas where thin bands of loamy material are at a depth of 40 to 60 inches; areas where the surface layer is thicker than typical; and areas where part of of the surface layer has been lost through erosion.

This Boyer soil has a higher available water capacity than Boyer loamy sand, 2 to 6 percent slopes. Runoff is slow. The erosion hazard is slight.

This soil is suitable for growing special crops under irrigation and is a good source of sand and gravel. Most of the acreage is cropped to corn, small grain, or hay. Capability unit IIIs–4; woodland group 3o1; wildlife group 1.

Briggsville Series

The Briggsville series consists of well drained and moderately well drained loamy soils. These soils formed in loamy deposits less than 18 inches thick and the underlying reddish, calcareous, water-laid sediment, generally of a heavy silty clay loam or silty clay texture. They are in lake basins and on valley floors adjacent to lake basins. Slopes range from 2 to 8 percent. The native vegetation was deciduous forest.

In a representative profile the surface layer is very dark grayish-brown loam about 7 inches thick. The subsurface layer is brown loam about 3 inches thick. The subsoil is about 48 inches thick. The upper 3 inches is dark-brown, friable sandy clay loam; the next 8 inches is dark reddish-brown, friable heavy silty clay loam; and the lower 37 inches is reddish-brown, firm silty clay. The substratum is reddish-brown, moderately alkaline heavy silty clay loam.

In some places, these soils are saturated at a depth of about 3 to 5 feet for significant periods during wet seasons. Permeability is moderately slow. Available water capacity and fertility are high.

These soils are a good source of clay. Most of the acreage is cultivated.

Representative profile of Briggsville loam, 2 to 8 percent slopes, 510 feet west and 30 feet north of the southeast corner of NE¼ sec. 11, T. 13 N., R. 7 E.

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) loam, light brownish gray (10YR 6/2) dry; weak, fine, subangular blocky structure; friable; many fine roots; slightly acid; abrupt, smooth boundary.

A2—7 to 10 inches, brown (10YR 4/3) loam; weak, thin, platy structure; friable; common fine roots; about 2 percent gravel; slightly acid; clear, wavy boundary.

B1—10 to 13 inches, dark-brown (7.5YR 4/4) sandy clay loam; moderate, medium, subangular blocky structure; friable; common fine roots; about 1 percent gravel; common light-gray (10YR 7/2) coatings on faces of peds; medium acid; clear, wavy boundary.

B21t—13 to 21 inches, dark reddish-brown (5YR 3/4) heavy silty clay loam; strong, very fine, angular blocky structure; friable; common fine roots; many thin clay films on faces of peds; common light-gray (10YR 7/2) coatings on faces of peds; medium acid; clear, wavy boundary.

B22t—21 to 32 inches, reddish-brown (5YR 4/3) silty clay; strong, fine, angular blocky structure; firm; common fine roots; continuous thin clay films on faces of peds; about 1 percent gravel; medium acid; clear, wavy boundary.

B23t—32 to 41 inches, reddish-brown (5YR 4/4) silty clay; weak, medium, prismatic structure parting to moderate, fine, angular blocky; firm; few fine roots; many thin clay films on faces of peds; about 2 percent gravel; slightly acid; clear, wavy boundary.

B3t—41 to 58 inches, reddish-brown (5YR 4/4) silty clay; weak, coarse, prismatic structure; firm; few fine roots; many thin clay films on vertical faces of prisms; about 2 percent gravel; moderately alkaline; gradual, wavy boundary.

C—58 to 60 inches, reddish-brown (5YR 5/3) heavy silty clay loam; strong, medium, platy structure; firm; moderately alkaline; slight effervescence.

The solum typically ranges from 50 to 60 inches in thickness but in places ranges from 45 inches to more than 60 inches. Depth to carbonates is more than 40 inches. The content of gravel in the solum ranges from about 0 to 8 percent. The Ap horizon ranges from very dark grayish brown (10YR 3/2) to brown (10YR 4/3). It has a higher value than 5.5 dry. In some places the A1 horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 4/2) to pale brown (10YR 6/3) and from 0 to 6 inches in thickness. The B1 horizon is heavy loam or sandy clay loam. The upper 20 inches of the Bt horizon is about 35 to 50 percent clay. In some places, the B horizon is mottled below a depth of 30 inches. In places, the C horizon is stratified silt loam, silty clay loam, and silty clay.

The Briggsville soils in this survey area have a thicker solum, a greater depth to carbonates, and less silt and more sand in the upper part of the solum than is defined as the range for the series.

Briggsville soils occur with Briggsville variant and Poygan soils. They have less silt in the upper part of the B horizon than the Briggsville variant soils. They are better drained than Poygan soils and have a thinner A horizon that is lower in content of silt and organic matter than that of the poorly drained Poygan soils.

Briggsville loam, 2 to 8 percent slopes (BsB).—Irregularly shaped areas of this soil are in lake basins and on terraces and floors of valleys adjacent to lake basins. Some areas range up to 200 acres in size. In some small areas part of the surface layer has been lost through water erosion. In some places, the lower part of the subsoil is mottled.

Included with this soil in mapping are a few small areas where the surface and subsurface layers are fine sandy loam or silt loam, areas where the substratum is sand and gravel outwash, areas where the loamy surface sediment is about 20 to 30 inches thick, nearly level areas, and stony areas, which are indicated by spot symbols on the soil map.

Runoff is slow. The erosion hazard is slight.

This soil is well suited to cultivated crops. The acreage is cropped to corn or hay. Capability unit IIe–6; woodland group 2c1; wildlife group 2.

Briggsville Variant

The Briggsville variant consists of well drained and moderately well drained silty soils. These soils formed in silty deposits, 30 to 40 inches thick, and the underlying reddish, calcareous, water-laid sediment, generally of a heavy silty clay loam or silty clay texture. They are on high terraces and in valleys adjacent to lake basins. Slopes range from 1 to 6 percent. The native vegetation was deciduous forest.

In a representative profile the surface layer is dark grayish-brown silt loam about 8 inches thick. The subsoil extends to a depth of more than 60 inches. The upper 6 inches is dark yellowish-brown, friable silt loam; the next 18 inches is dark yellowish-brown, firm heavy silt loam; the next 6 inches is dark-brown, firm heavy silt loam; and the lower 22 inches is reddish-brown, firm silty clay.

In some places, these soils are saturated at a depth of about 3 to 5 feet for significant periods during wet seasons. Permeability is moderate to a depth of about 38 inches and moderately slow below that depth. Available water capacity and fertility are high.

Most of the acreage is cultivated.

Representative profile of Briggsville silt loam, silty subsoil variant, 1 to 6 percent slopes, eroded, 140 feet west and 480 feet south of the northeast corner of SW¼ sec. 19, T. 13 N., R. 7 E.

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; weak, fine, subangular blocky structure; friable; common fine roots; neutral; abrupt, smooth boundary.

B1—8 to 14 inches, dark yellowish-brown (10YR 4/4) silt loam; weak, medium, subangular blocky structure; friable; common fine roots; neutral; clear, wavy boundary.

B21t—14 to 32 inches, dark yellowish-brown (10YR 4/4) heavy silt loam; moderate, medium, subangular blocky structure; firm; common fine roots; few thin clay films on faces of peds; slightly acid; clear, wavy boundary.

B22t—32 to 38 inches, dark-brown (10YR 4/3) heavy silt loam; moderate, medium, subangular blocky structure; firm; common fine roots; few thin clay films on faces of peds; slightly acid; abrupt, smooth boundary.

IIB23t—38 to 54 inches, reddish-brown (5YR 4/3) silty clay; moderate, medium, prismatic structure parting to moderate, medium, angular blocky; firm; few fine roots; many thin clay films on faces of peds; slightly acid; clear, wavy boundary.

IIB3t—54 to 60 inches, reddish-brown (5YR 4/3) silty clay; weak, medium, prismatic structure; firm; few fine roots; common thin clay films on faces of prisms; neutral.

The solum ranges from 45 to more than 60 inches in thickness. Depth to the clay material ranges from 30 to 40 inches. The Ap horizon ranges from very dark grayish brown (10YR 3/2) to brown (10YR 4/3). Color value is more than 5.5 dry. The upper part of the B horizon which formed in silty material, is silt loam, heavy silt loam, or light clay loam in texture and is dark brown (7.5YR 4/4 or 10YR 4/3) or dark yellowish brown (10YR 4/4). Reaction is medium acid or slightly acid below the depth affected by agricultural lime. The IIB horizon is commonly reddish brown (5YR 4/3 to 5/4) silty clay or heavy silty clay loam. Reaction is medium acid or slightly acid but ranges to mildly alkaline in the lower part. The upper 20 inches of the Bt horizon is about 18 to 30 percent clay. In some places, the B horizon is mottled below a depth of about 30 inches.

Briggsville variant soils occur with Briggsville and Poygan soils. They have more silt and less clay in the upper part of the B horizon than Briggsville and Poygan soils. In addition, they are not so wet as Poygan soils.

Briggsville silt loam, silty subsoil variant, 1 to 6 percent slopes, eroded (BtB2).—Irregularly shaped areas of this soil are on valley sides and on high terraces adjacent to lake basins near Mt. Carroll and Seaton soils. Areas range up to 70 acres in size. In some concave areas this soil is not eroded, and the lower part of the subsoil in these areas is seasonally saturated.

Included with this soil in mapping are small areas of Briggsville loam, 2 to 8 percent slopes. Also included are areas where the surface layer and upper part of the subsoil have a higher content of sand and some gravel or are statified silt and fine sand; a few areas where

the silty surface sediment is more than 40 inches thick or less than 30 inches thick; areas where slope is more than 6 percent; and areas, indicated by spot symbols on the soil map, where a few stones are on the surface.

Runoff is medium. The erosion hazard is slight on the less sloping areas. The underlying clayey material tends to restrict internal drainage.

This soil is well suited to crops. Most of the acreage is cultivated. Capability unit IIe–1; woodland group 2c1; wildlife group 2.

Channahon Series

The Channahon series consists of well-drained silty soils underlain at a depth of 10 to 20 inches by limestone bedrock (fig. 7). These soils formed in shallow deposits of silt and the underlying loamy glacial till. They occur along ridges and on the crests and sides of rises on silt-covered till plains. Outcrops of limestone bedrock are indicated by spot symbols on the soil map. The native vegetation was prairie grasses.

In a representative profile the surface layer is silt loam about 12 inches thick. The upper 9 inches is very dark brown, and the lower 3 inches is very dark grayish brown. The subsoil is dark-brown, friable heavy silt loam about 4 inches thick that contains some gravel. It is underlain at a depth of about 16 inches by limestone bedrock.

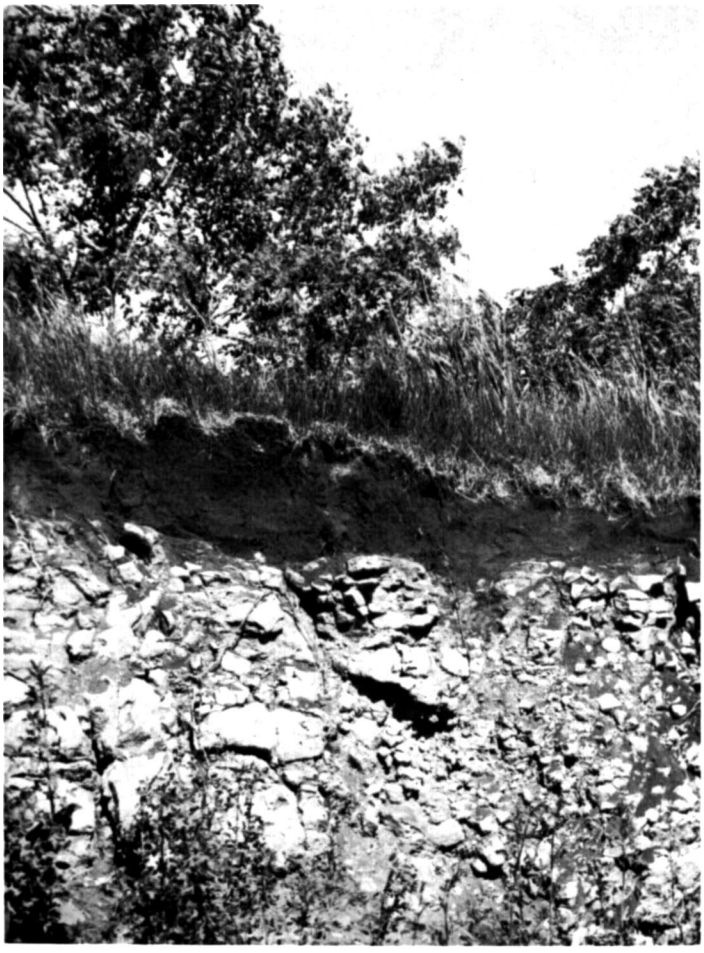

Figure 7.—Channahon soil is shallow over limestone bedrock.

Limestone bedrock, at a depth of about 10 to 20 inches, restricts roots and many uses of these soils. Permeability is moderate. Available water capacity is low, and fertility is medium. The soils are droughty during dry seasons.

Most of the acreage is used for pasture. The underlying limestone is mined and crushed in many areas.

Representative profile of Channahon silt loam, 12 to 30 percent slopes, eroded, in an uneroded area 324 feet north and 45 feet west of the southeast corner of NE¼NE¼ sec. 31, T. 11., R. 12 E.

A1—0 to 9 inches, very dark brown (10YR 2/2) silt loam; moderate, very fine, subangular blocky structure; very friable; many fine roots; moderately alkaline; clear, wavy boundary.

A3—9 to 12 inches, very dark grayish brown (10YR 3/2) silt loam; moderate, very fine, subangular blocky structure; very friable; common fine roots; about 1 percent gravel; moderately alkaline; clear, wavy boundary.

Bt—12 to 16 inches, dark-brown (10YR 3/3) heavy silt loam; moderate, fine and very fine, subangular blocky structure; friable; common fine roots; about 1 percent gravel; many thin clay films; moderately alkaline; abrupt, wavy boundary.

R—16 to 60 inches, limestone bedrock.

Thickness of the solum and depth to the limestone bedrock range from 10 to 20 inches. Reaction ranges from slightly acid to moderately alkaline. The A horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2) and is more than one-third the thickness of the solum. The Bt horizon is dark-brown (10YR 3/3 to 4/3) or dark yellowish-brown (10YR 3/4 to 4/4) heavy silt loam, silty clay loam, heavy loam, or sandy clay loam. The content of fine sand or coarser particles ranges from about 15 to 50 percent.

Channahon soils are similar to Knowles, Ripon, and Northfield soils. They are shallower over limestone than Knowles or Ripon soils. They are less than 20 inches deep over limestone, whereas Northfield soils are less than 20 inches deep over sandstone.

Channahon silt loam, 2 to 6 percent slopes (CaB).—This soil is on the crests of ridges and on the sides of slight rises on the till plain. Areas are irregularly shaped and commonly 20 to 40 acres in size. Tillage has mixed the upper and lower parts of the surface layer in most areas.

Included with this soil in mapping are small areas of Ripon silt loam, 2 to 6 percent slopes. Also included are a few small, nearly level areas; areas where the bedrock is at a depth of less than 10 inches; and areas where part of the surface layer has been lost through erosion. In some small areas the surface layer is loam or fine sandy loam.

Use of this Channahon soil for septic tank filter fields is restricted because it is too shallow over limestone. Runoff is slow. The erosion hazard is slight.

Most of the acreage is cropped to legumes, corn, or small grain. Some is used for pasture. Growth of crops is limited by the shallow root zone and the low available water capacity. Capability unit IIIe–3; woodland group 5d1; wildlife group 3.

Channahon silt loam, 6 to 12 percent slopes, eroded (CaC2).—This soil is along ridges and on the sides and crests of rises on the till plain. Areas are commonly

long and range from 10 to 30 acres in size. The present surface layer is 7 to 10 inches thick. About 2 to 5 inches of the original surface layer has been lost through erosion. In tilled areas, part of the subsoil has been mixed with the remaining original surface layer.

Included with this soil in mapping are small areas of Ripon silt loam, 6 to 12 percent slopes, eroded. Also included are a few small areas where bedrock is at a depth of less than 10 inches and areas where the surface layer is loam or fine sandy loam. In some places, bedrock is just below the surface layer.

Runoff is medium. The erosion hazard is moderate.

This soil is poorly suited to cultivated crops, and growth of crops is limited by low available water capacity. Most of the acreage is used for pasture. Some is cultivated and cropped to legumes. Capability unit IVe–3; woodland group 5dl; wildlife group 3.

Channahon silt loam, 12 to 30 percent slopes, eroded (CaE2).—This soil is in long, narrow areas along ridges on the till plain. Areas range up to 40 acres in size. The soil has the profile described as representative of the series, but in cultivated areas tillage has mixed the upper part of the subsoil and the subsurface layer with the original surface layer, and part of this has been lost through erosion.

Included with this soil in mapping are small areas of Knowles silt loam, 12 to 20 percent slopes, eroded. In many small areas, bedrock is within a depth of 10 inches. In some places the surface layer rests directly on bedrock, and in many places it is only 6 to 8 inches thick. In a few places, the slope is more than 30 percent.

Runoff is rapid to very rapid. The erosion hazard is severe.

This soil is poorly suited to cultivated crops. Most of the acreage is used as pasture or left idle. Capability unit VIIe–3; woodland group 5d2; wildlife group 3.

Chelsea Series

The Chelsea series consists of excessively drained sandy soils that formed in deep deposits of sand. These soils are on terraces and valley sides and along ridges. Finer textured material occurs in thin bands at a depth of 40 to 60 inches or more. Small blowouts are common and are indicated by spot symbols on the soil map. The native vegetation was dominantly oak forest.

In a representative profile, the surface layer is loamy fine sand about 9 inches thick. The upper 2 inches is dark brown, and the lower 7 inches is brown. Just below the surface layer is about 16 inches of yellowish-brown loamy fine sand. This is underlain by about 20 inches of light yellowish-brown fine sand. Yellowish-brown and brownish-yellow fine sand are between depths of about 45 inches and 60 inches. This layer contains thin bands of dark-brown and dark reddish-brown light sandy loam.

These soils are droughty and very susceptible to blowing if the plant cover is removed. Permeability is rapid in the sandy material but is moderately rapid below a depth of 40 inches and in the thin bands of finer textured material. Available water capacity and fertility are low.

Chelsea soils are poorly suited to general farm crops.

Representative profile of Chelsea loamy fine sand, 6 to 12 percent slopes, 339 feet west and 489 feet south of the northeast corner of SE¼ sec. 17, T. 13 N., R. 10 E.

Ap1—0 to 2 inches, dark-brown (10YR 3/3) loamy fine sand; weak, fine, subangular blocky structure; very friable; many fine roots; slightly acid; abrupt, smooth boundary.

Ap2—2 to 9 inches, brown (10YR 4/3) loamy fine sand; weak, medium, subangular blocky structure; very friable; common fine roots; neutral; abrupt, smooth boundary.

A21—9 to 25 inches, yellowish-brown (10YR 5/4) loamy fine sand; weak, coarse, subangular blocky structure; very friable; few fine roots; neutral; clear, smooth boundary.

A22—25 to 45 inches, light yellowish-brown (10YR 6/4) fine sand; single grained; loose; few fine roots; neutral; abrupt, smooth boundary.

A2&B—45 to 60 inches, yellowish-brown (10YR 5/6) and brownish-yellow (10YR 6/6) fine sand; single grained; loose; bands of dark-brown (7.5YR 4/4) and dark reddish-brown (5YR 3/4) light sandy loam at depths of 45 to 49, 51 to 55, and 57 to 59 inches; massive; friable; many thin clay bridges between mineral grains in the bands; neutral.

The solum is commonly slightly acid or neutral but ranges to medium acid. The B horizon has a slightly lower reaction than the A2 horizon. The Ap horizon is dark brown (10YR 3/3), dark grayish brown (10YR 4/2), or brown (10YR 4/3). Where it occurs, the A1 horizon is very dark gray (10YR 3/1), very dark brown (10YR 2/2), or very dark grayish brown (10YR 3/2) and less than 5 inches thick. The A21 horizon ranges from brown (10YR 4/3) to yellowish-brown (10YR 5/4) fine sand or loamy fine sand. The lower part of the A2 horizon ranges from yellowish brown (10YR 5/4) to brownish yellow (10YR 6/6). The B horizon, consisting of bands ¼ inch to 5 inches thick, is dark reddish-brown (5YR 3/4), dark-brown (7.5YR 4/4), or dark yellowish-brown (10YR 3/4 to 4/4) loamy sand, loamy fine sand, fine sandy loam, or light sandy loam. Depth to the uppermost band is more than 40 inches, and the total thickness of the bands above a depth of 60 inches is more than 6 inches.

The Chelsea soils in this survey area have a greater cumulative thickness of banding above a depth of 60 inches and are less acid than is defined as the range for the series.

Chelsea soils are similar to Plainfield and Puchyan soils. Unlike Plainfield soils, they have textural bands at a depth of 40 to 60 inches. Unlike Puchyan soils, the part of their solum within a depth of 40 inches did not form in silty sediment.

Chelsea loamy fine sand, 1 to 6 percent slopes (ChB).—This soil is on terraces and on the sides of slight rises on the outwash plain. Areas are long and irregularly shaped and commonly 20 to 40 acres in size. Where tilled, the surface layer is dark brown or brown. On some terraces, the bands have a loam texture and mottles occur at a depth of about 30 to 50 inches.

Included with this soil in mapping are small areas of Plainfield loamy fine sand, 2 to 6 percent slopes, and Plainfield loamy fine sand, loamy substratum, 2 to 6 percent slopes. Also included are a few small areas where the bands are within a depth of 40 inches; areas where part of the surface layer has been lost through soil blowing; and areas where the cumulative thickness of the bands within a depth of 60 inches is less than 6 inches.

Runoff is slow. The hazard of water erosion is slight.

This soil is better suited to deep-rooted plants than to other plants because the bands are more fertile and less droughty than the sandy material above them.

Much of the acreage was cultivated at one time, but most is now wooded or pastured. Some areas are planted to coniferous trees. Capability unit IVs–3; woodland group 3s1; wildlife group 3.

Chelsea loamy fine sand, 6 to 12 percent slopes (ChC).—This soil is on valley sides, along ridges, and on the sides of rises on the outwash plain. Areas are commonly long and range from 5 to 20 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Plainfield loamy fine sand, loamy substratum, 6 to 12 percent slopes, and Plainfield loamy fine sand, 6 to 12 percent slopes. Also included are a few small areas where the surface layer is loamy sand; areas where bands occur above a depth of 40 inches; areas where the cumulative thickness of the bands within a depth of 60 inches is less than 6 inches; and areas where mottles occur at a depth of about 30 to 50 inches.

Runoff is medium. The hazard of water erosion is slight.

This soil is better suited to deep-rooted plants than to other plants because the bands contain most of the available water and nutrients. Some of the acreage is pastured or wooded. Capability unit VIs–3; woodland group 3s1; wildlife group 3.

Colwood Series

The Colwood series consists of poorly drained loamy soils. These soils formed in stratified silt and sand deposits. They are on glacial lake plains, in stream valleys and depressions, and on valley floors of drainageways. Slopes range from 0 to 3 percent. The native vegetation was mixed grasses.

In a representative profile the surface layer is about 21 inches thick. The upper 10 inches is black fine sandy loam, the next 9 inches is black heavy silt loam, and the lower 2 inches is very dark fine sandy loam. The subsoil is about 16 inches thick. The upper 2 inches is dark-gray, friable silty clay loam; the next 9 inches is grayish-brown, friable loam; and the lower 5 inches is olive-gray, very friable loam. The substratum is olive-gray stratified sand, light loam, and loamy sand.

These soils are subject to ponding after a heavy rainfall. Areas adjacent to streams are subject to occasional flooding. Permeability is moderate. Available water capacity and fertility are high. Ground water is at or near the surface throughout most of the year.

In adequately drained areas, these soils are cropped (fig. 8). Many areas are used as pasture or wildlife habitat.

Figure 8.—Sweet corn and hay on Colwood soil. If adequately drained, this soil is well suited to crops.

Representative profile of Colwood fine sandy loam, 0 to 3 percent slopes, in a clover field 45 feet north and 75 feet east of the southwest corner of NW¼SW¼ sec. 35, T. 11 N., R. 11 E.

Ap—0 to 10 inches, black (10YR 2/1) fine sandy loam; moderate, fine, granular structure; very friable; many fine roots; slightly acid; abrupt, smooth boundary.

A12—10 to 19 inches, black (10YR 2/1) heavy silt loam; common, fine, prominent, yellowish-red (5YR 4/6) mottles; weak, coarse, subangular blocky structure; friable; common fine roots; slightly acid; clear, wavy boundary.

A13—19 to 21 inches, very dark gray (10YR 3/1) fine sandy loam; few, fine, prominent, strong-brown (7.5YR 5/6) mottles; weak, coarse, subangular blocky structure; very friable; common fine roots; slightly acid; abrupt, wavy boundary.

B21g—21 to 23 inches, dark-gray (10YR 4/1) silty clay loam; many, fine, prominent, strong-brown (7.5YR 5/6) mottles; weak, fine, subangular blocky structure; friable; common fine roots; neutral; abrupt, wavy boundary.

B22g—23 to 32 inches, grayish-brown (2.5Y 5/2) loam; many, fine, prominent, yellowish-brown (10YR 5/6) mottles; weak, coarse, subangular blocky structure; friable; few fine roots; neutral; clear, wavy boundary.

B3g—32 to 37 inches, olive-gray (5Y 5/2) loam; few, fine, prominent, yellowish-red (5YR 4/6) mottles and common, fine, prominent, yellowish-brown (10YR 5/6) mottles; weak, coarse, subangular blocky structure; very friable; few fine roots; neutral; abrupt, wavy boundary.

C1—37 to 39 inches, olive-gray (5Y 5/2) sand; single grained; loose; moderately alkaline; slight effervescence; abrupt, wavy boundary.

C2—39 to 42 inches, olive-gray (5Y 5/2) light loam; few, medium, prominent, yellowish-red (5YR 4/8) mottles and common, fine, prominent, yellowish-brown (10YR 5/6) mottles; massive; very friable; neutral; abrupt, wavy boundary.

C3—42 to 60 inches, olive-gray (5Y 5/2) loamy sand; single grained; loose; neutral.

The solum typically ranges from 30 to 40 inches in thickness but in places ranges from 24 to 50 inches. It is dominantly slightly acid to neutral, but ranges to mildly alkaline. The A horizon ranges from 10 to 21 inches in thickness and from black (10YR 2/1) to very dark grayish brown (10YR 3/2) in color. The B horizon is 14 to 30 inches thick. The weighted textural class is heavy loam, sandy clay loam, or clay loam. Layers of silt loam, sandy loam, or light loam are in the B horizon in some places. A distinguishing feature of these soils is stratification of coarse textured and medium-textured sediment in the B horizon, the C horizon, or both, above a depth of 40 inches. The matrix of the B horizon has chroma of 1 or 2. The C horizon is generally stratified silt or loam and sand.

The Colwood soils in this survey area are generally more acid than is defined as the range for the series. In many places, carbonates do not occur above a depth of 40 inches.

Colwood soils occur with Gilford soils and form a drainage sequence with the well-drained Sisson soils and the somewhat poorly drained Kibbie soils. Colwood soils contain more clay between a depth of 10 and 40 inches than Gilford soils.

Colwood fine sandy loam, 0 to 3 percent slopes (CoA).—Large, irregularly shaped areas of this soil are on glacial lake plains and in depressions. Many long areas are in stream valleys and along drainageways.

Included with this soil in mapping are small areas where the surface is covered with a few inches of muck. In some small areas the substratum is mostly sand that has a few thin silt bands. Also included are small areas of Gilford fine sandy loam, stratified substratum, 0 to 3 percent slopes; some small areas where the surface layer is silt loam; and other small areas where the substratum is mostly silt.

Draining this Colwood soil is difficult because the silt and sand tend to flow easily if the soil is saturated. Runoff is very slow to ponded. The erosion hazard is slight.

If adequately drained, this soil is used for crops. Undrained areas are used as pasture or woodland. Controlling wetness is the major concern in management. Capability unit IIw–1; woodland group 1w5; wildlife group 5b.

Dodge Series

The Dodge series consists of well-drained silty soils that formed in 26 to 36 inches of silty sediment and the underlying calcareous sandy loam glacial till. These soils are on silt-covered till plains. Slopes range from 2 to 20 percent. The native vegetation was deciduous forest.

In a representative profile the surface layer is very dark grayish-brown silt loam about 8 inches thick. The subsoil is about 31 inches thick. The upper 3 inches is dark-brown, friable silt loam; the next 13 inches is dark yellowish-brown, friable heavy silt loam; the next 6 inches is dark yellowish-brown, friable silty clay loam; the next 4 inches is dark yellowish-brown, friable sandy clay loam; and the lower 5 inches is dark-brown friable sandy clay loam. The substratum is yellowish-brown, strongly effervescent sandy loam.

Permeability is moderate. Available water capacity and fertility are high.

Most of the acreage is cultivated.

Representative profile of Dodge silt loam, 6 to 12 percent slopes, eroded, in a cornfield 36 feet south and 171 feet west of the northeast corner of NE¼SE¼ sec. 31, T. 13 N., R. 12 E.

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; weak, fine, subangular blocky structure; friable; many fine roots; neutral; abrupt, smooth boundary.

B1t—8 to 11 inches, dark-brown (10YR 4/3) silt loam; weak, fine and medium, subangular blocky structure; friable; common fine roots; common fine and few medium and coarse tubular pores; few thin clay films on faces of peds; neutral; clear, wavy boundary.

B21t—11 to 24 inches, dark yellowish-brown (10YR 4/4) heavy silt loam; moderate, fine, subangular blocky structure; friable; common fine roots; common fine tubular pores; common thin clay films on faces of peds; medium acid; gradual, wavy boundary.

B22t—24 to 30 inches, dark yellowish-brown (10YR 4/4) silty clay loam; moderate, medium, subangular blocky structure; friable; few fine roots; common fine and few medium tubular pores; common thin clay films on faces of peds; medium acid; clear, wavy boundary.

IIB23t—30 to 34 inches, dark yellowish-brown (10YR 3/4) sandy clay loam; moderate, medium, subangular blocky structure; friable; few fine roots; many fine and few medium tubular pores; about 2 percent gravel; common thin clay films on faces of peds, and many moderately thick clay bridges between mineral grains; slightly acid; clear, wavy boundary.

IIB24t—34 to 39 inches, dark-brown (7.5YR 3/4) sandy clay loam; weak, coarse, subangular blocky structure; friable; few fine roots; many fine, common

medium, and few coarse tubular pores; about 2 percent gravel; few thin clay films on faces of peds, and many thin clay bridges between mineral grains; mildly alkaline; abrupt, wavy boundary.

IIC—39 to 60 inches, yellowish-brown (10YR 5/4) sandy loam; massive; very friable; about 13 percent gravel; strong effervescence.

The solum typically ranges from 35 to 40 inches in thickness but in places ranges from 30 to 40 inches. Depth to the till material ranges from 26 to 36 inches. The Ap horizon is very dark grayish brown (10YR 3/2), dark grayish brown (10YR 4/2), or dark brown (10YR 3/3 to 4/3) and ranges from 6 to 9 inches in thickness. The B horizon is dark-brown (10YR 4/3) to yellowish-brown (10YR 5/4) silt loam, heavy silt loam, and silty clay loam. The IIB horizon is commonly sandy clay loam, but in some places it is heavy sandy loam.

The Dodge soils in this survey area have more sand in the lower part of the B horizon and the C horizon than is defined as the range for the series.

Dodge soils occur with Knowles, McHenry, and St. Charles soils and are similar to Baraboo soils. In contrast with Knowles and Baraboo soils, they are not underlain by bedrock. They contain more silt and less sand in the upper 20 inches of the Bt horizon than McHenry soils. They have a thinner silt mantle and solum than the St. Charles soils.

Dodge silt loam, 2 to 6 percent slopes, eroded (DoB2).—This soil is in long, irregularly shaped areas on rises on the till plain near St. Charles and McHenry soils. Areas are commonly 30 to 60 acres in size. The silt mantle is commonly 32 to 36 inches thick, but otherwise, the profile is similar to the one described as representative of the series.

Included with this soil in mapping are small areas of McHenry silt loam, 2 to 6 percent slopes, eroded, and St. Charles silt loam, 2 to 6 percent slopes, eroded. In a few small areas the subsoil extends to a depth of 42 to 50 inches and in some bedrock is at a depth of 40 to 60 inches. Also included are areas where there is little or no erosion and areas where slopes are less than 2 percent.

In the more sloping areas, runoff is medium and the erosion hazard is moderate. Erosion is the major limitation.

Most of the acreage is cultivated, but some is forested. Capability unit IIe–1; woodland group 2o1; wildlife group 1.

Dodge silt loam, 6 to 12 percent slopes, eroded (DoC2). This soil is in long areas on rises and along ridges on the till plain near McHenry and St. Charles soils. Areas range up to 60 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of McHenry silt loam, 6 to 12 percent slopes, eroded, and St. Charles silt loam, 6 to 12 percent slopes, eroded. In a few small areas, the subsoil extends to a depth of more than 40 inches and in some bedrock is at a depth of 40 to 60 inches.

Runoff is medium. The erosion hazard is moderate. Erosion is the major limitation.

This soil is cropped to corn, small grain, and hay. A few areas are forested or pastured. Capability unit IIIe–1; woodland group 2o1; wildlife group 1.

Dodge silt loam, 12 to 20 percent slopes, eroded (DoD2).—This soil is in long, narrow areas along ridges and on rises on the till plain near McHenry, St. Charles, and Lapeer soils. Areas are commonly 10 to 20 acres in size. In wooded areas the surface layer is black to very dark grayish brown and is about 2 to 4 inches thick, and the subsurface layer is brown and is about 3 to 8 inches thick.

Included with this soil in mapping are small areas of McHenry silt loam, 12 to 20 percent slopes, eroded, and St. Charles silt loam, 12 to 20 percent slopes, eroded. Also included are a few steeper areas, some areas where the subsoil extends to a depth of more than 40 inches, and some where bedrock is at a depth of 40 to 60 inches.

Runoff is rapid. The erosion hazard is severe. Erosion is the major limitation.

This soil is generally not suited to intensive cropping. Most of the acreage is cropped to legumes. Some is cropped to corn or used as pasture or woodland. Capability unit IVe–1; woodland group 2r2; wildlife group 1.

Dresden Series

The Dresden series consists of well-drained loamy soils underlain at a depth of 24 to 40 inches by calcareous stratified sand and gravel outwash. Some gravel pits are indicated by spot symbols on the soil map. Slopes are commonly 1 to 12 percent but range to 20 percent. The native vegetation was mixed grasses and deciduous trees.

In a representative profile the surface layer is very dark brown loam about 8 inches thick. The subsoil is about 18 inches thick. The upper 5 inches is dark yellowish-brown, friable heavy loam; the next 9 inches is dark-brown, friable sandy clay loam; and the lower 4 inches is dark-brown, very friable gravelly light sandy clay loam. The substratum is light yellowish-brown, mildly alkaline stratified sand and gravel.

Permeability is moderate in the subsoil and rapid or very rapid in the substratum. Available water capacity is low, and fertility is medium. Roots are restricted by the sand and gravel substratum.

These soils are an important source of sand and gravel. Most of the acreage is cultivated.

Representative profile of Dresden loam, 1 to 6 percent slopes, in a cornfield 660 feet west and 450 feet north of the southeast corner of NE¼NE¼ sec. 4, T. 12 N., R. 10 E.

Ap—0 to 8 inches, very dark brown (10YR 2/2) loam; weak, medium, subangular blocky structure; friable; common fine roots; neutral; abrupt, smooth boundary.

B21t—8 to 13 inches, dark yellowish-brown (10YR 4/4) heavy loam; weak, medium, subangular blocky structure; friable; common fine roots; about 2 percent gravel; continuous thin clay bridges between mineral grains; neutral; clear, wavy boundary.

B22t—13 to 22 inches, dark-brown (7.5YR 4/4) sandy clay loam; moderate, medium, subangular blocky structure; friable; common fine roots; about 8 percent gravel; many thin clay films on faces of peds; neutral; abrupt, wavy boundary.

IIB3t—22 to 26 inches, dark-brown (7.5YR 3/2) gravelly light sandy clay loam; weak, medium, subangular blocky structure; very friable; common fine roots; about 45 percent gravel; continuous, moderately thick clay bridges between mineral grains; neutral; abrupt, wavy boundary.

IIC—26 to 60 inches, light yellowish-brown (10YR 6/4) stratified sand and gravel; single grained; loose; mildly alkaline; slight effervescence.

The solum typically ranges from 24 to 32 inches in thickness but in places ranges from 24 to 40 inches. The Ap horizon is very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2) and ranges from 6 to 9 inches in thickness. The B2t horizon is dark-brown (7.5YR 3/4) or dark yellowish-brown (10YR 3/4 or 4/4) heavy loam, sandy clay loam, or clay loam. The IIB horizon is dark brown (7.5YR 3/2 or 4/4), dark yellowish brown (10YR 3/4), or very dark grayish brown (10YR 3/2). It is commonly gravelly sandy loam or gravelly sandy clay loam. Reaction in the B horizon is medium acid to neutral.

Dresden soils occur with Boyer, Lorenzo, and Oshtemo soils. The A horizon contains more organic matter and the B horizon contains more clay than those of Boyer and Oshtemo soils. Dresden soils have a thicker solum than Lorenzo soils.

Dresden loam, 1 to 6 percent slopes (DrB).—Irregularly shaped areas of this soil are on slight rises on the outwash plain. These areas are 20 to 60 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Lorenzo loam, 2 to 6 percent slopes, and Boyer fine sandy loam, 2 to 6 percent slopes. Also included are some areas where the subsoil extends to a depth of more than 40 inches; areas where the surface layer is 10 inches or more thick or is lighter colored; and areas where the substratum is mostly sand. Also included are many small areas where the surface layer is silt loam or fine sandy loam and some small convex areas where part of the surface layer has been lost through erosion.

Runoff is slow. The erosion hazard is slight.

This soil is well suited to cultivated crops and is a good source of sand and gravel. Most of the acreage is cropped to corn, small grain, or alfalfa. Capability unit IIe–2; woodland group 2o1; wildlife group 1.

Dresden loam, 6 to 12 percent slopes, eroded (DrC2).—Irregularly shaped or long areas of this soil are along ridges and on rises on the outwash plain. Slopes are short and complex. Areas range from 5 to 20 acres in size. This soil has a profile similar to the one described as representative of the series, but the surface layer is commonly very dark grayish-brown loam about 6 or 7 inches thick.

Included with this soil in mapping are small areas of Lorenzo loam, 6 to 12 percent slopes, eroded. Also included are some areas where the surface layer is silt loam or fine sandy loam; areas where the substratum is sand; areas where the subsoil is dominantly heavy sandy loam; and areas where the surface layer is lighter colored.

Runoff is medium. The erosion hazard is moderate.

This soil is a good source of sand and gravel (fig. 9). Most of the acreage is cultivated. Corn and alfalfa are commonly grown. Capability unit IIIe–2; woodland group 2o1; wildlife group 1.

Dresden loam, 12 to 20 percent slopes, eroded (DrD2).—Small long and narrow areas of this soil are along rises on the outwash plain. The surface layer is 5 or 6 inches thick and, in some places, this soil has a subsurface layer of dark grayish-brown or brown loam about 2 to 5 inches thick. In some more eroded spots material from the subsoil is exposed at the surface.

Included with this soil in mapping are small areas of Lorenzo loam, 12 to 20 percent slopes, eroded. Also included are a few small areas where the surface layer is silt loam or fine sandy loam, areas where the substratum is sand, areas where the subsoil is dominantly sandy loam, areas where the slope is more than 20 percent, and areas where the surface layer is lighter in color.

Figure 9.—**The substratum of this Dresden soil is an important source of sand and gravel in Columbia County.**

Runoff is rapid. The erosion hazard is severe. Erosion is the major limitation.

This soil is poorly suited to cultivated crops, but it is a good source of sand and gravel. It is used mainly as pasture or for growing alfalfa. Some of the acreage is cropped to corn. Capability unit IVe–2; woodland group 2r2; wildlife group 1.

Friesland Series

The Friesland series consists of nearly level and gently sloping, well drained and moderately well drained loamy soils. These soils formed in 20 to 40 inches of loamy sediment and the underlying silty sediment that extends to a depth of 50 inches or more.

They occupy broad upland basins and till plains. The native vegetation was mixed grasses.

In a representative profile the surface layer is fine sandy loam about 19 inches thick. In sequence from the top, it is very dark brown, very dark grayish brown, and dark brown. The subsoil is dark yellowish brown and about 26 inches thick. The upper 10 inches is friable heavy fine sandy loam; the next 6 inches is firm heavy loam, and the lower 10 inches is mottled firm heavy silt loam. The substratum is mixed grayish-brown and dark yellowish-brown firm silt loam.

In most areas Friesland soils are saturated at a depth of 3 to 5 feet for significant periods during wet seasons. Permeability is moderate. Available water capacity and fertility are high.

Friesland soils are well suited to general farm crops. Corn is grown in most areas.

Representative profile of Friesland fine sandy loam, 1 to 6 percent slopes, 645 feet west and 831 feet south of the northeast corner of NW¼ sec. 16, T. 10 N., R. 7 E.

Ap—0 to 9 inches, very dark brown (10YR 2/2) fine sandy loam; moderate, fine and very fine, subangular blocky structure; friable, slightly sticky, slightly plastic; many fine roots; few fine tubular pores; slightly acid; abrupt, smooth boundary.

A12—9 to 15 inches, very dark grayish-brown (10YR 3/2) fine sandy loam; moderate, medium, subangular blocky structure; friable, slightly sticky, slightly plastic; many fine roots; common fine and few coarse tubular pores; slightly acid; clear, wavy boundary.

A13—15 to 19 inches, dark-brown (10YR 3/3) fine sandy loam; moderate, medium, subangular blocky structure; friable, slightly sticky, slightly plastic; many fine roots; common fine and few coarse tubular pores; medium acid; clear, wavy boundary.

B21t—19 to 29 inches, dark yellowish-brown (10YR 3/4) heavy fine sandy loam; moderate, medium, subangular blocky structure; friable, slightly sticky, slightly plastic; common fine roots; common fine and few medium and coarse tubular pores; few, thin, patchy dark-brown (10YR 3/3) clay films; medium acid; gradual, wavy boundary.

B22t—29 to 35 inches, dark yellowish-brown (10YR 4/4) heavy loam; moderate, fine, subangular blocky structure; firm, slightly sticky, slightly plastic; common fine roots; common fine and few medium and coarse tubular pores; few, thin, patchy dark-brown (10YR 3/3) clay films; medium acid; clear, wavy boundary.

IIB23t—35 to 45 inches, dark yellowish-brown (10YR 4/4) heavy silt loam; few, fine, faint, brown (10YR 5/3) mottles and few, fine, distinct, yellowish-red (5YR 4/6) mottles; moderate, medium, subangular blocky structure; firm, slightly sticky, slightly plastic; few fine roots; common fine and medium tubular pores; thin, patchy clay films; medium acid; gradual, wavy boundary.

IIC—45 to 60 inches, mixed grayish-brown (10YR 5/2) and dark yellowish-brown (10YR 4/4) silt loam; massive; firm, slightly sticky, slightly plastic; few fine and common medium tubular pores; thin clay lining in pores toward upper boundary; slightly acid.

The solum ranges from 36 to 60 inches in thickness. It formed in two-layered parent material consisting of 20 to 40 inches of loam, sandy loam, or fine sandy loam and a lower layer of silty seriment. The A horizon is 10 to 20 inches thick. The B2t horizon is 9 to 20 inches thick. It is dark yellowish brown (10YR 3/4 to 4/4) or brown (7.5YR 4/4 to 5/4) and is 7 to 20 inches thick. Commonly a few high-chroma mottles are in the soil below a depth of about 35 inches. The C horizon is slightly acid to mildly alkaline.

Friesland soils are similar to the Grellton and the Salter variant soils. They occur with Grellton, mottled subsoil variant, soils. Their A horizon is thicker and contains more organic matter than that of the Grellton soils. Unlike the Salter variant soils, which formed in stratified silt and sand, they formed in loamy and silty sediment. They are not so wet as the Grellton, mottled subsoil variant, soils, and they have a thicker A horizon.

Friesland fine sandy loam, 1 to 6 percent slopes (FrB).—Most areas of this soil are in large, broad upland basins slightly lower than adjacent silt-capped glacial uplands.

Included with this soil in mapping are small areas of Puchyan loamy sand, 2 to 6 percent slopes, and Grellton fine sandy loam, 1 to 6 percent slopes. Also included are areas where glacial till is at a depth of 40 to 60 inches and small areas where the loamy surface sediment is less than 20 inches deep.

Runoff is slow. The hazard of water erosion is slight.

This soil is well suited to cultivated crops. Most of the acreage is cultivated. Corn and peas are commonly grown. Capability unit IIe–1; woodland group not classified; wildlife group 4.

Gilford Series

The Gilford series consists of poorly drained loamy soils that formed in stratified silt and sand. These soils are on glacial lake plains and in stream valleys. Slopes are 0 to 3 percent. The native vegetation was mixed grasses.

In a representative profile the surface layer is black fine sandy loam about 14 inches thick. The subsoil is about 18 inches thick. The upper 3 inches is dark-gray sandy clay loam, the next 7 inches is dark grayish-brown heavy sandy loam, and the lower 8 inches is gray and yellowish-brown fine sandy loam. The upper 10 inches of the substratum is grayish-brown, yellowish-brown, and brownish-yellow stratified loamy sand and fine sand. This overlies gray and yellowish-brown stratified silt loam and medium sand.

Permeability is moderate. Available water capacity and fertility are medium. Ground water is at or near the surface throughout most of the year.

In adequately drained areas, these soils are cropped. Many areas are used as pasture or wildlife habitat.

Representative profile of Gilford fine sandy loam, stratified substratum, 0 to 3 percent slopes, 168 feet east and 297 feet north of the southwest corner of NW¼SE¼ sec. 8, T. 13 N., R. 11 E.

Ap—0 to 9 inches, black (10YR 2/1) fine sandy loam; moderate, medium and fine, subangular blocky structure; friable, slightly sticky, slightly plastic; many fine roots; few fine tubular pores; mildly alkaline; abrupt, smooth boundary.

A12—9 to 14 inches, black (10YR 2/1) fine sandy loam; common, medium, distinct, dark-gray (10YR 4/1) mottles, few, fine, distinct, dark grayish-brown (10YR 4/2) mottles, and few, medium, prominent, red (2.5YR 5/6) mottles; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; friable, slightly sticky, slightly plastic; common fine roots; few medium and many fine tubular pores; mildly alkaline; clear, wavy boundary.

B21g—14 to 17 inches, dark-gray (10YR 4/1) sandy clay loam; common, fine, prominent, olive-brown (2.5Y 4/4) and yellowish-brown (10YR 5/6) mottles; weak; coarse, prismatic structure; friable, sticky,

plastic; common fine roots; few coarse, common medium, and many fine tubular pores; mildly alkaline; clear, wavy boundary.

B22g—17 to 24 inches, dark grayish-brown (10YR 4/2) heavy sandy loam; common, medium, prominent, yellowish-brown (10YR 5/6) mottles; weak, coarse, prismatic structure parting to moderate, coarse, subangular blocky; friable, sticky, slightly plastic; common fine roots; few coarse, few medium and many fine tubular pores; mildly alkaline; clear, wavy boundary.

B3g—24 to 32 inches, gray (10YR 5/1) and yellowish-brown (10YR 5/6) fine sandy loam; nearly continuous gray (10YR 5/1) coatings on faces of peds; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; friable, slightly sticky, slightly plastic; few fine roots; 1 percent gravel; few medium and many fine tubular pores; mildly alkaline; clear, wavy boundary.

C1g—32 to 42 inches, grayish-brown (10YR 5/2), yellowish-brown (10YR 5/6), and brownish-yellow (10YR 6/6) stratified loamy sand and fine sand; weak, coarse and medium, subangular blocky structure; very friable; few fine roots; 3 percent fine gravel; mildly alkaline; abrupt, wavy boundary.

C2—42 to 60 inches, gray (5Y 6/1) and yellowish-brown (10YR 5/6) stratified silt loam and medium sand; massive; friable, slightly sticky, plastic; mildly alkaline.

The solum ranges from 30 to 40 inches in thickness and is dominantly slightly acid to mildly alkaline. The A horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2). It is 10 to 18 inches thick. The B2g horizon is 5 to 14 inches thick. The weighted textural class is heavy sandy loam, light loam, or silt loam that has a high content of sand coarser than very fine. Layers of heavy loam or sandy clay loam are in the B horizon in some places. A distinguishing feature of these soils is stratification of moderately fine textured and medium-textured and coarse-textured sediment in the B horizon, in the C horizon, or both, above a depth of 40 inches. The B3g horizon is 5 to 10 inches thick.

Gilford soils occur with Colwood, Granby, and Yahara soils. They are less clayey than Colwood soils. They are more clayey than Granby soils, which formed in sandy sediment. They are wetter than Yahara soils.

Gilford fine sandy loam, stratified substratum, 0 to 3 percent slopes (GaA).—Large, irregularly shaped areas of this soil are on glacial lake plains. Many long areas are in stream valleys and along drainageways.

Included with this soil in mapping are small areas where a few inches of muck is on the surface. Some small areas are mostly sand and have only a few thin bands of silt. Also included are some small areas of Granby loamy sand and Colwood fine sandy loam, 0 to 3 percent slopes.

This Gilford soil is subject to ponding in spring and after a heavy rain. Draining this soil is difficult because the silt and sand tend to flow easily if saturated. Runoff is very slow. The erosion hazard is slight. Some areas along streams are subject to occasional flooding.

In adequately drained areas, this soil is cropped. Most of the acreage is pastured or wooded. Controlling wetness is the major concern in management. Capability unit IVw-3; woodland group 4w4; wildlife group 5b.

Granby Series

The Granby series consists of nearly level, poorly drained sandy soils that formed in deep deposits of sand. These soils are on outwash plains and river flood plains. The native vegetation was marsh grasses, reeds, sedges, and water-tolerant trees.

In a representative profile the surface layer is black loamy sand about 11 inches thick. It typically is high in content of organic matter. The subsoil is about 14 inches thick. The upper 5 inches is dark-gray loamy sand, and the lower 9 inches is grayish-brown sand. The substratum is light brownish-gray neutral sand.

In some places, these soils are seasonally droughty and subject to blowing where the plant cover is removed. Permeability is rapid. Available water capacity and fertility are low. Ground water is at or near the surface throughout most of the year. Areas adjacent to streams are subject to occasional flooding. When saturated, the sandy substratum of these soils tends to flow easily.

Where drained, these soils are cropped to small grain, hay, and some soybeans, corn, and vegetables. Undrained areas are used as pasture or woodland.

Representative profile of Granby loamy sand (0 to 2 percent slopes), 150 feet east and 660 feet south of the northwest corner of NE¼SE¼ sec. 21, T. 13 N., R. 7 E.

Ap—0 to 11 inches, black (N 2/0) loamy sand high in content of organic matter; weak, coarse, subangular blocky structure; very friable; common fine roots; slightly acid; abrupt, smooth boundary.

B2g—11 to 16 inches, (10YR 4/1) loamy sand; common, coarse, faint, very dark gray (10YR 3/1) mottles in upper part; weak, coarse, subangular blocky structure; very friable; few fine roots, slightly acid; clear, wavy boundary.

B3—16 to 25 inches, grayish-brown (2.5Y 5/2) sand; single grained; loose; few fine roots; neutral; gradual, wavy boundary.

C—25 to 60 inches, light brownish-gray (2.5Y 6/2) sand; single grained; loose; neutral.

The A horizon ranges from 11 to 15 inches in thickness and from black (10YR 2/1) to very dark grayish brown (10YR 3/2). The B horizon ranges from dark-gray (10YR or 2.5Y 4/1) to light brownish-gray (10YR or 2.5Y 6/2) loamy sand or sand. Reaction in the B horizon ranges from medium acid to neutral.

Granby soils occur with Marshan, Morocco, and Gilford soils. They contain less clay and more sand in the solum than Marshan soils. They are wetter than the somewhat poorly drained Morocco soils. Unlike Gilford soils, which formed in deposits of stratified silt and sand, they formed in deposits of sand.

Granby loamy sand (0 to 2 percent slopes) (Gb).—This soil is on flood plains, outwash plains, and lake plains. Areas are typically irregularly shaped, but some long, narrow areas are adjacent to drainageways or border large basins of organic soils. Many areas of this soil range up to 600 acres in size.

Included with this soil in mapping are small areas of Adrian muck; Morocco loamy sand, 0 to 3 percent slopes; and Gilford fine sandy loam, stratified substratum, 0 to 3 percent slopes. Also included are a few spots of Marsh, which are indicated by spot symbols on the soil map; some small areas where the surface layer is muck; and small areas where discontinuous bands of loamy material are at a depth of 40 to 60 inches.

Runoff is very slow. Wetness, occasional flooding, and low fertility are the major limitations.

Even in adequately drained areas, this soil is poorly suited to the crops commonly grown in the survey area. It can be used for some special crops. Most drained areas are used for truck crops and corn. Many areas

are used as pasture. Capability unit IVw-5; woodland group 3w4; wildlife group 5b.

Grellton Series

The Grellton series consists of nearly level to sloping, well drained and moderately well drained loamy soils. In most areas these soils formed in three layers of different parent material. In some they formed only in the upper two layers. The upper 20 to 40 inches of this material is loamy sediment, the middle layer is silty sediment, and the lower layer is calcareous loamy glacial till. These soils are in broad upland basins, on ground moraines, and in valleys between glacial drumlins. The native vegetation was mainly oak forest.

In a representative profile the surface layer is very dark grayish-brown fine sandy loam about 5 inches thick. The subsoil is about 50 inches thick. The upper 10 inches is brown, very friable fine sandy loam; the next 8 inches is dark-brown, friable heavy loam; the next 4 inches is dark-brown, friable heavy silt loam; the next 20 inches is dark yellowish-brown, friable silt loam; and the lower 8 inches is dark-brown, very friable fine sandy loam. The substratum is yellowish-brown, calcareous sandy loam glacial till.

In most areas the nearly level and gently sloping Grellton soils are seasonally saturated at a depth of 3 to 5 feet. Permeability is moderate. Available water capacity and fertility are high.

Grellton soils are suitable for all general farm crops.

Representative profile of Grellton fine sandy loam, 1 to 6 percent slopes, 200 feet south and 500 feet west of the northeast corner of SW¼ sec. 6, T. 10 N., R. 11 E.

Ap—0 to 5 inches, very dark grayish-brown (10YR 3/2) fine sandy loam; weak, coarse, subangular blocky structure; very friable; many fine roots; few worm casts; slightly acid; abrupt, smooth boundary.

B1—5 to 15 inches, brown (10YR 4/3) fine sandy loam; weak, medium, subangular blocky structure; very friable; many fine roots; few worm casts; slightly acid; clear, wavy boundary.

B21t—15 to 23 inches, dark-brown (7.5YR 4/4) heavy loam; moderate, medium, subangular blocky structure; friable; few fine roots; few worm casts; few thin clay films on faces of peds and in pores; slightly acid; clear, wavy boundary.

IIB22t—23 to 27 inches, dark-brown (7.5YR 4/4) heavy silt loam; moderate, fine and medium, subangular blocky structure; friable; few fine roots; common thin clay films on faces of peds in pores; medium acid; clear, wavy boundary.

IIB23t—27 to 39 inches, dark yellowish-brown (10YR 4/4) silt loam; moderate, fine, subangular blocky structure; friable; few fine roots; few thin clay films on faces of peds; medium acid; clear, wavy boundary.

IIB31—39 to 47 inches, dark yellowish-brown (10YR 4/4) silt loam; weak, coarse, subangular blocky structure; friable; slightly acid; clear, wavy boundary.

IIIB32—47 to 55 inches, dark-brown (7.5YR 4/4) fine sandy loam; weak, coarse, subangular blocky structure; very friable; about 5 percent gravel; slightly acid; clear, wavy boundary.

IIIC—55 to 60 inches, yellowish-brown (10YR 5/4) sandy loam; massive; very friable; about 14 percent gravel; strong effervescence.

The solum typically ranges from 50 to 60 inches in thickness, but in places ranges from 40 to 60 inches. The loamy upper story material ranges from 20 to 40 inches in thickness. The solum is slightly or medium acid in the B1 horizon, slightly to strongly acid in the B2t and IIB2t horizons, and neutral to medium acid in the B3 horizon. The Ap horizon ranges from very dark grayish brown (10YR 3/2) to dark brown (10YR 4/3). The A2 horizon, which occurs in some places, is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2), is fine sandy loam, has platy structure, and is 1 to 3 inches thick. The B1 horizon is sandy loam, fine sandy loam, or loam 4 to 10 inches thick. The B2t horizon is dark-brown (7.5YR 4/4) or dark yellowish-brown (10YR 4/4) loam, heavy loam, or sandy clay loam 6 to 12 inches thick. The IIB horizon is silt loam or silty clay loam 16 to 33 inches thick. The IIIB3 horizon of fine sandy loam, sandy loam, or sandy clay loam does not occur in some areas. In many areas the silty second layer extends to a depth more than 60 inches, and a IIIC horizon of silt loam is at a depth of 50 to 60 inches.

Grellton soils are similar to Friesland and Puchyan soils and are near Grellton variant. Their A horizon is thinner and lower in organic-matter content than that of Friesland soils. They have more clay in the upper part of the B horizon than Puchyan soils. They are similar in texture to the Grellton variant, but they are not mottled throughout the B horizon.

Grellton fine sandy loam, 1 to 6 percent slopes (GeB).—The larger areas of this soil are in broad upland basins and on till plains. Some long, broad areas are on the foot slopes of till ridges. Most areas are slightly lower than the adjacent silt-capped glacial uplands. This soil has the profile described as representative of the Grellton series.

Included with this soil in mapping are small areas of Puchyan loamy fine sand, 2 to 6 percent slopes. Also included are small areas, generally where this soil borders a deep silty soil, where the loamy surface sediment is less than 20 inches thick and some areas where the surface layer is very dark brown and is 6 to 9 inches thick.

Runoff is slow. The hazard of water erosion is slight.

This soil is well suited to row crops. Most of the acreage is cultivated. Corn is the chief crop, but some of the acreage is cropped to peas, small grain, and legumes. Capability unit IIe-1; woodland group 2o1; wildlife group 1.

Grellton fine sandy loam, 6 to 12 percent slopes, eroded (GeC2).—This soil is on the sides of till ridges. Areas are long and narrow and mostly less than 30 acres in size. This soil has a profile similar to the one described as representative of the series, but in cultivated areas tillage has mixed the upper part of the subsoil and subsurface layer with the original surface layer, and part of this material has been lost through erosion.

Included with this soil in mapping are small areas of Puchyan loamy fine sand, 6 to 12 percent slopes, and other areas where the loamy surface sediment is less than 20 inches thick. Also included are some small areas where the surface layer is darker colored and areas where the slope is more than 12 percent.

Runoff is medium. The hazard of water erosion is moderate.

Most of the acreage is cultivated, mainly to corn, small grain, and hay. Some is pastured or wooded. Capability unit IIIe-1; woodland group 2o1; wildlife group 1.

Grellton Variant

The Grellton variant consists of somewhat poorly drained loamy soils. These soils formed in 20 to 40 inches of loamy sediment and the underlying silty sediment. They are in low-lying upland basins and on valley floors between till ridges. Slopes are 0 to 4 percent. The native vegetation was grasses and hardwoods.

In a representative profile the surface layer is very dark brown fine sandy loam about 9 inches thick. The subsoil is about 41 inches thick. The upper 7 inches is dark-brown, very friable sandy loam; the next 5 inches is dark yellowish-brown, very friable heavy sandy loam; the next 4 inches is yellowish-brown, friable loam; the next 8 inches is grayish-brown, friable silty clay loam; and the lower 17 inches is grayish-brown friable silty loam. The substratum is olive-gray, mildly alkaline silt loam.

These soils are saturated at a depth of 1 to 3 feet for significant periods during wet seasons. Permeability is moderate. Available water capacity and fertility are high.

Grellton variant soils are used mainly for crops and pasture. Some areas are in woodland.

Representative profile of Grellton fine sandy loam, mottled subsoil variant, 0 to 4 percent slopes, in a cornfield, 33 feet west and 60 feet north of the southeast corner of NE¼SW¼ sec. 35, T. 11 N., R. 11 E.

Ap—0 to 9 inches, very dark brown (10YR 2/2) fine sandy loam; weak, coarse, subangular blocky structure; friable; common fine roots; neutral; abrupt, wavy boundary.

B1—9 to 16 inches, dark-brown (10YR 4/3) sandy loam; few, fine, faint, dark yellowish-brown (10YR 4/4) mottles; weak, coarse, subangular blocky structure; very friable; few fine roots; very dark brown (10YR 2/2) material in large pores; neutral; gradual, wavy boundary.

B21—16 to 21 inches, dark yellowish-brown (10YR 4/4) heavy sandy loam; few, fine, distinct, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/6) mottles; weak, coarse, subangular blocky structure; very friable; few fine roots; slightly acid; clear, wavy boundary.

B22t—21 to 25 inches, yellowish-brown (10YR 5/4) loam; common, fine, distinct, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; friable; few fine roots; few thin clay films; slightly acid; clear, wavy boundary.

IIB23tg—25 to 33 inches, grayish-brown (2.5Y 5/2) silty clay loam; common, fine, prominent, strong-brown (7.5YR 5/6) and yellowish-brown (10YR 5/6) mottles; moderate, fine, subangular blocky structure; friable; few fine roots; few thin clay films; slightly acid; clear, wavy boundary.

IIB3g—33 to 50 inches, grayish-brown (2.5Y 5/2) silt loam; common, medium, prominent, strong-brown (7.5YR 5/6) and yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; friable; few fine roots; neutral; gradual, wavy boundary.

IICg—50 to 60 inches, olive-gray (5Y 5/2) silt loam; few, medium, prominent, yellowish-red (5YR 4/6) and yellowish-brown (10YR 5/6) mottles; massive; friable; mildly alkaline; slight effervescence.

The solum ranges from 30 to 55 inches in thickness. The loamy upper-story sediment ranges from 20 to 40 inches in thickness. The solum is typically slightly acid or neutral, but in some places it is medium acid. The A horizon is 6 to 9 inches thick and is very dark brown (10YR 2/2), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2). The B1 horizon is dark-brown (10YR 4/3) or brown (10YR 5/3) fine sandy loam or sandy loam 4 to 12 inches thick. The B2 horizon is heavy sandy loam, loam, or sandy clay loam 6 to 15 inches thick. The IIB horizon is grayish brown (10YR to 2.5Y 5/2) or olive gray (5Y5/2) and is 12 to 30 inches thick. The IIB2 horizon is heavy silt loam or silty clay loam.

Grellton variant soils are near the well drained and moderately well drained Friesland and Grellton soils. They have a thinner A horizon than Friesland soils. They have poorer drainage than Grellton soils.

Grellton fine sandy loam, mottled subsoil variant, 0 to 4 percent slopes (GnA).—This soil is in irregularly shaped areas in low-lying upland basins and in long areas on valley floors between till ridges. Most areas are 10 to 20 acres in size.

Included with this soil in mapping are small areas where till underlies the silty sediment at a depth of 40 to 60 inches. Also included are some small areas where the upper part of the subsoil has more sand and less clay than is typical, other small areas where the silty lower sediment contains thin strata of sand, and small areas, adjacent to areas of silty soils, where the loamy surface sediment is less than 20 inches thick.

Runoff is slow. The erosion hazard is slight. Wetness is the major limitation.

If adequately drained, this soil is well suited to the crops commonly grown in the county. It is used mainly for crops or pasture. Wooded areas have a thick understory of plant cover that provides good habitat for certain species of wildlife. Capability unit IIw–2; woodland group 2o1; wildlife group 5a.

Griswold Series

The Griswold series consists of well-drained silty soils that formed in calcareous sandy loam glacial till mantled with as much as 18 inches of silt. These soils are on till plains. Slopes range from 2 to 20 percent. The native vegetation was grasses.

In a representative profile the surface layer is about 13 inches thick. The upper 8 inches is very dark brown silt loam, and the lower 5 inches is very dark grayish-brown silt loam. The subsoil is about 25 inches thick. The upper 10 inches is dark yellowish-brown, friable heavy sandy clay loam; the next 6 inches is dark yellowish-brown, very friable sandy clay loam; and the lower 9 inches is dark yellowish-brown, friable sandy loam. The substratum is yellowish-brown, moderately alkaline sandy loam.

Permeability is moderate. Available water capacity and fertility are medium.

Most of the acreage is cultivated.

Representative profile of Griswold silt loam, 2 to 6 percent slopes, eroded, in an uneroded area in a cornfield, 57 feet south and 300 feet east of the northwest corner of NE¼SE¼ sec. 10, T. 13 N., R. 12 E.

Ap—0 to 8 inches, very dark brown (10YR 2/2) silt loam; weak, medium, subangular blocky structure; very friable; common fine roots; neutral; abrupt, smooth boundary.

A12—8 to 13 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, fine, subangular blocky structure; friable; common fine roots; neutral; clear, wavy boundary.

IIB21t—13 to 23 inches, dark yellowish-brown (10YR 3/4) heavy sandy clay loam; moderate, fine, subangular blocky structure; friable; few fine roots; about 4 percent gravel; common thin clay films on faces of peds and many moderately thick clay bridges between mineral grains; slightly acid; clear, wavy boundary.

IIB22t—23 to 29 inches, dark yellowish-brown (10YR 4/4) sandy clay loam; weak, medium, subangular blocky structure; friable; few fine roots; about 5 percent gravel; few thin clay films on faces of peds and many thin clay bridges between mineral grains; slightly acid; clear, wavy boundary.

IIB3t—29 to 38 inches, dark yellowish-brown (10YR 4/4) sandy loam; weak, medium, subangular blocky structure; very friable; few fine roots; about 5 percent gravel; common thin clay bridges between mineral grains; slightly acid; clear, wavy boundary.

IIC—38 to 60 inches, yellowish-brown (10YR 5/4) sandy loam; massive; very friable; about 12 percent gravel; moderately alkaline; slight effervescence.

The solum typically ranges from 30 to 40 inches in thickness but in places ranges from 20 to 40 inches. Depth to the till material ranges up to 18 inches. The A horizon ranges from 8 to 18 inches in thickness and from black (10YR 2/1) to dark brown (10YR 3/3) in color. The B horizon is dark brown (7.5YR 4/4) or dark yellowish brown (10YR 3/4–4/4). It is commonly heavy sandy loam, light sandy clay loam, sandy clay loam, or light clay loam, but ranges to sandy loam in the lower part. In some places, the upper few inches of the B horizon is heavy silt loam or silty clay loam. Reaction in the B horizon is commonly slightly acid or neutral but ranges from medium acid to mildly alkaline. The weighted average clay content in the upper 20 inches of the Bt horizon ranges from 18 to about 26 percent. The C horizon is light sandy loam or sandy loam glacial till. In some places, it is gravelly.

The well-drained Griswold soils occur in a drainage sequence with the somewhat poorly drained Marcellon soils and the poorly drained Barry soils. They also occur with Ringwood and Winneshiek soils. They have less silt and more sand in the upper part of the B horizon than Ringwood soils. They are deeper than Winneshiek soils, which are less than 60 inches deep over limestone.

Griswold silt loam, 2 to 6 percent slopes, eroded (GrB2).—This soil is in irregularly shaped or long areas on the crests of rises on the till plain. Areas are commonly 20 to 40 acres in size. In the northeastern part of the survey area, the till is highly calcareous in places and contains many flat pieces of limestone. This soil has the profile described as representative of the series, but in most places the surface layer is slightly thinner and depth to the substratum is slightly less.

Included with this soil in mapping are small areas of Ringwood silt loam, 1 to 6 percent slopes, eroded. Also included are a few small areas where the surface layer is loamy or contains some gravel, areas where the subsoil is dominantly sandy loam, and a few sand spots and areas that are only slightly eroded.

Runoff is medium. The erosion hazard is moderate in the more sloping areas.

This soil has no serious limitations and is well suited to the crops commonly grown in the survey area. Most of the acreage is cropped to corn, small grain, or legumes. Capability unit IIe–1; woodland group not classified; wildlife group 4.

Griswold silt loam, 6 to 12 percent slopes, eroded (GrC2).—This soil is commonly in long, somewhat narrow areas on the crests of rises and on recessional moraines on the till plain. Areas range from 10 to 30 acres in size. In some places, the till is highly calcareous. This soil has a profile similar to that described as representative of the series, but the surface layer is 2 to 5 inches thinner and the substratum is at a depth of about 22 to 30 inches.

Included with this soil in mapping are small areas of Ringwood silt loam, 6 to 12 percent slopes, eroded. Also included are a few areas where the surface layer is loamy or contains some gravel, areas where the subsoil is dominantly sandy loam; and areas where the surface layer and subsoil combined is less than 20 inches thick.

Runoff is medium. The erosion hazard is moderate.

Most of the acreage is cropped to corn or legumes. Some is used as pasture. Capability unit IIIe–1; woodland group not classified; wildlife group 4.

Griswold silt loam, 12 to 20 percent slopes, eroded (GrD2).—This soil is generally in long, narrow areas along ridges, on knobs, and on recessional moraines on the till plain. Areas are generally less than 20 acres in size. This soil has a profile similar to that described as representative of the series, but the surface layer is 4 to 6 inches thinner and the substratum is at a depth of about 20 to 30 inches.

Included with this soil in mapping are small areas where the surface layer and subsoil combined is less than 20 inches thick, areas where the surface layer is loamy or is gravelly, and areas where the subsoil is sandy loam. In a few areas the silt mantle is more than 18 inches thick.

Runoff is rapid. The erosion hazard is severe. Some areas are severely eroded.

Most of the acreage is cropped to legumes or used as pasture. Erosion is a serious concern in cultivated areas. Capability unit IVe–1; woodland group not classified; wildlife group 4.

Houghton Series

The Houghton series consists of nearly level, very poorly drained organic soils. These soils are deep deposits of well-decomposed residue from water-tolerant plants. They are in old glacial lakebeds and broad depressions and along major streams and drainageways. The native vegetation was mainly reeds and sedges.

In a representative profile the surface layer is dark reddish-brown muck about 14 inches thick. This is underlain by black and dark reddish-brown muck that extends to a depth of more than 51 inches.

Unless these soils are drained, ground water is at or near the surface throughout most of the year. Permeability is moderately rapid. Available water capacity is very high. Fertility is low.

Drained areas are cropped intensively to corn, truck crops, and mint, and some acreage is used for growing sod for lawns. Undrained areas are suitable for permanent pasture or for use as wildlife habitat.

Representative profile of Houghton muck (0 to 2 percent slopes) in a tamarack swamp 660 feet east and 100 feet north of the southwest corner of SE¼ sec. 10, T. 13 N., R. 7 E.

Oa1—0 to 5 inches, dark reddish-brown (5YR 2/2) sapric material; about 5 percent fiber, 1 percent rubbed; weak, coarse, subangular blocky structure; very friable; primarily herbaceous fibers; moderately alkaline (pH 8.0 in H_2O); abrupt, smooth boundary.

Oa2—5 to 14 inches, dark reddish-brown (5YR 2/2) sapric material, dark reddish brown (5YR 3/2) pressed; about 20 percent fiber, 3 percent rubbed; weak, thick, platy structure; friable; primarily herbaceous fibers; neutral (pH 7.0 in H_2O); abrupt, smooth boundary.

Oa3—14 to 40 inches, black (5YR 2/1) sapric material; dark reddish brown (5YR 2/2) pressed; about 7 percent fiber, 1 percent rubbed; massive; very friable; primarily herbacerous fibers; about 2 percent woody fragments; neutral (pH 7.0 in H_2O); clear, wavy boundary.

Oa4—40 to 60 inches, dark reddish-brown (5YR 2/2) sapric material, dark reddish brown (5YR 3/3) pressed; about 9 percent fiber; neutral (pH 7.0 in H_2O).

The organic material is more than 51 inches thick and is primarily herbaceous, but in some places contains woody fragments. The layers are black, dark reddish brown, or very dark brown. They are dominantly muck, but thin layers of peat are in some places.

Houghton soils are near Adrian, Boots, and Palms soils. They formed in thicker deposits of organic material than Adrian and Palms soils. They are more decomposed than Boots soils.

Houghton muck (0 to 2 percent slopes) (Ho).—The larger areas of this soil are in old lakebeds and large depressions and on broad valley floors along major streams. Smaller areas are in small depressions and on narrow valley floors along minor drainageways.

Included with this soil in mapping are small areas of Adrian and Palms muck, mostly where Houghton muck borders Adrian muck or Palms muck. Also included are small areas of Wallkill soils, where mineral soil material was deposited over Houghton muck by runoff from the uplands; some small areas of Boots muck in areas of stagnant water; small areas of open water and Marsh, both of which are shown by spot symbols on the soil map; and small areas along major streams that have thin strata of mineral soil.

This Houghton muck is subject to ponding in spring and after a heavy rain. Runoff is very slow. Areas along major streams are subject to occasional flooding. Where drainage has been installed and cultivated crops are grown, soil blowing and subsidence are hazards.

Most of the larger areas of this soil are cultivated (fig. 10). Corn and truck crops are commonly grown. Sod for lawns and mint are grown in some areas. Drained areas of this soil can be intensively cropped if fertility is maintained and if blowing and subsidence are controlled. Undrained areas are used as pasture or left as wildlife habitat. Capability unit IIIw–9; woodland group not classified; wildlife group 6.

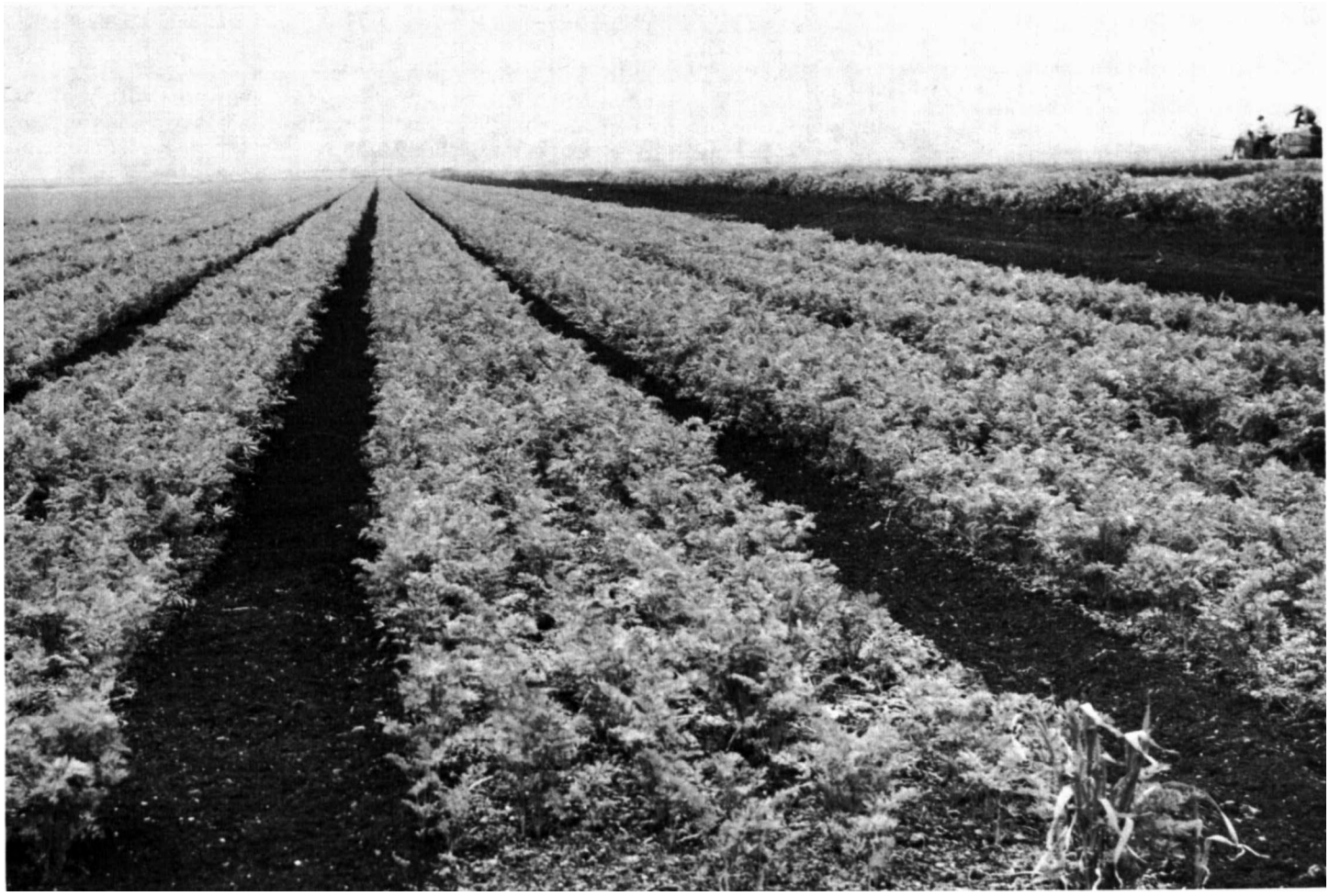

Figure 10.—**Carrots on a drained Houghton muck. This soil is highly susceptible to blowing after harvest.**

Joy Series

The Joy series consists of somewhat poorly drained silty soils. These soils formed in deep deposits of silty sediment. They are on low terraces in depressions and on broad valley floors in till plains. Slopes range from 0 to 4 percent. The native vegetation was prairie grasses.

In a representative profile the surface layer is silt loam about 21 inches thick. The upper 17 inches is black, and the lower 3 inches is very dark grayish brown. The subsoil is about 25 inches thick. The upper 4 inches is dark grayish-brown, friable silt loam; the next 8 inches is dark grayish-brown, friable heavy silt loam; and the lower 13 inches is grayish-brown, friable silt loam. The substratum is olive-gray, moderately alkaline silt loam.

These soils are saturated at a depth of about 1 to 3 feet for significant periods during wet seasons. Permeability is moderate. Available water capacity and fertility are high.

Most of the acreage is cultivated. Corn or vegetable crops are commonly grown.

Representative profile of Joy silt loam, 0 to 4 percent slopes, in a field of peas 115 feet east and 260 feet south of the northwest corner of SE¼ sec. 2, T. 12 N., R. 12 E.

Ap—0 to 8 inches, black (10YR 2/1) silt loam; weak, fine, subangular blocky structure; very friable; many very fine roots; few coarse tubular pores; neutral; abrupt, smooth boundary.

A12—8 to 13 inches, black (10YR 2/1) silt loam; moderate, very fine, subangular blocky structure; very friable; many very fine roots; few very fine and medium tubular pores; neutral; abrupt, wavy boundary.

A13—13 to 17 inches, black (10YR 2/1) silt loam; weak, fine and very fine, subangular blocky structure; friable; common very fine roots; few medium and common fine and very fine tubular pores; medium acid; clear, wavy boundary.

A3—17 to 21 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, fine and very fine, subangular blocky structure; friable; common very fine roots; common medium and many fine and very fine tubular pores; medium acid; abrupt, wavy boundary.

B21—21 to 25 inches, dark grayish-brown (10YR 4/2) silt loam; few, fine, distinct, yellowish-brown (10YR 5/4) mottles and common, fine, faint, grayish-brown (10YR 5/2) mottles; weak, medium, prismatic structure parting to moderate, fine and medium, subangular blocky; friable; common very fine roots; common medium and many fine and very fine tubular pores; few black (N 2/0) stains on faces of peds; common thin clay films on faces of peds and few thin clay films in pores; medium acid; clear, wavy boundary.

B22—25 to 33 inches, dark grayish-brown (10YR 4/2) heavy silt loam; common, fine, distinct and faint, strong-brown (7.5YR 5/6) and grayish-brown (2.5Y 5/2) mottles; weak, medium, prismatic structure parting to moderate, fine and medium, subangular blocky; friable; common very fine roots; few medium and common fine and very fine tubular pores; few black (N 2/0) stains on faces of peds; common fine clay films on faces of peds and few thin films on pores; medium acid; clear, wavy boundary.

B23g—33 to 39 inches, grayish-brown (2.5Y 5/2) silt loam; common, fine, prominent, strong-brown (7.5YR 5/6) mottles; weak, fine and medium, subangular blocky structure; friable; few very fine roots; common medium and many fine and very fine tubular pores; few thin clay films on faces of peds and in pores; common black (N 2/0) stains on faces of peds; slightly acid; clear, wavy boundary.

B3g—39 to 46 inches, grayish-brown (2.5Y 5/2) silt loam; common, fine, prominent, strong-brown (7.5YR 5/6) mottles; weak, medium and coarse, subangular blocky structure; friable; very few very fine roots; common medium and many fine and very fine tubular pores; few thin clay films in pores; common black (N 2/0) stains on faces of peds; slightly acid; gradual, wavy boundary.

C—46 to 60 inches, olive-gray (5Y 5/2) silt loam; few, medium, prominent, strong-brown (7.5YR 5/6) mottles; massive; very friable; few medium and common fine and very fine tubular pores; few black (N 2/0) stains on faces of peds; moderately alkaline; slight effervescence.

The solum ranges from 40 to 60 inches in thickness. It is typically slightly acid or medium acid, but in some places it is neutral. The A horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2) in color and from 14 to 23 inches in thickness. The B horizon is typically dark grayish brown (10YR 2.5Y–4/2) or grayish brown (10YR 2.5Y–5/2), but in some places it ranges to light yellowish brown (10YR 2.5Y-6/4) mainly in the lower part. Colors of 2 chroma are dominant in the upper part of the B horizon. The B horizon is typically silt loam, heavy silt loam, or light silty clay loam. The weighted average clay content in the B horizon is estimated to range from 18 to 26 percent.

Joy soils occur in a drainage sequence with the well drained and moderately well drained Plano soils. Unlike Plano soils, the lower part of their B horizon did not form in sandy loam glacial till. They are similar to Troxel soils, but have a thinner A horizon.

Joy silt loam, 0 to 4 percent slopes (JoA).—This soil is on low terraces bordering basins, in swales within areas of Plano soils, and on valley floors along drainageways. Areas are irregularly shaped or long and somewhat broad and range up to 100 acres in size.

Included with this soil in mapping are small areas of Troxel silt loam, 0 to 3 percent slopes; Ossian silt loam, 0 to 3 percent slopes; and Plano silt loam, 0 to 2 percent slopes. Also included are a few wet spots, which are indicated by spot symbols on the soil map; areas where the substratum is sand and gravel; and a few small areas where the lower part of the subsoil formed in glacial till.

Runoff is slow. There is little or no erosion hazard. Wetness is the major limitation. In nearly level areas, water ponds in spring and after a rainfall.

If adequately drained, this soil is well suited to the crops commonly grown in the survey area. Most areas are cropped to corn or peas. Capability unit IIw–2; woodland group 4o1; wildlife group 5a.

Kibbie Series

The Kibbie series consists of somewhat poorly drained loamy soils. These soils formed in stratified deposits of silt, fine sand, and very fine sand containing thin layers or lenses of finer or coarser textured sediment. They occupy depressions and valley floors along drainageways on lake plains and outwash plains. Some are on flood plains of major drainageways. Slopes range from 0 to 4 percent. The native vegetation was deciduous forest and some grasses.

In a representative profile the surface layer is very dark brown fine sandy loam about 8 inches thick. The subsoil is about 17 inches thick. The upper 12 inches is

brown, friable heavy loam, and the lower 5 inches is yellowish-brown, friable loam. The substratum is gray, slightly effervescent, stratified silt and fine sand.

These soils are saturated at a depth of about 1 to 3 feet for significant periods during wet seasons. Permeability is moderate. Available water capacity and fertility are high. Water is likely to pond in nearly level areas in spring and after a heavy rainfall. Some nearly level areas adjacent to major drainageways are subject to occasional flooding.

Most of the acreage is cultivated. Corn, small grain, and hay are the main crops. Some areas are used as pasture or woodland.

Representative profile of Kibbie fine sandy loam, 0 to 4 percent slopes, 396 feet south and 303 feet west of the northeast corner of SE¼SW¼ sec. 4, T. 11 N., R. 12 E.

Ap—0 to 8 inches, very dark brown (10YR 2/2) fine sandy loam; moderate, fine, subangular blocky structure; friable; common fine roots; about 1 percent gravel; few fine and coarse tubular pores; neutral; abrupt, smooth boundary.

B21t—8 to 20 inches, brown (10YR 4/3) heavy loam; few, fine, distinct and prominent, light brownish-gray (2.5Y 6/2) and strong-brown (7.5YR 5/8) mottles and common, fine, prominent, yellow (10YR 7/6) mottles; moderate, medium, subangular blocky structure; friable; common fine roots; about 1 percent gravel; many fine and few coarse tubular pores; common thin clay films on faces of peds; few worm casts 3 millimeters in diameter; neutral; clear, wavy boundary.

B22t—20 to 25 inches, yellowish-brown (10YR 5/4) loam; few, coarse, prominent, yellowish-brown (10YR 5/8) mottles and few, fine and medium, distinct, grayish-brown (2.5Y 5/2) and dark-brown (10YR 3/3) mottles; weak, coarse, subangular blocky structure; friable; few fine roots; about 1 percent gravel and 2 percent very coarse sand; many fine tubular pores; few thin clay films on faces of peds; mildly alkaline; clear, wavy boundary.

Cg—25 to 60 inches, gray (5Y 6/1) stratified silt and fine sand; few, fine, faint, light-gray (5Y 7/1) mottles and many, fine, prominent, strong-brown (7.5YR 5/8) mottles; massive; friable; slight effervescence.

The solum ranges from 24 to 40 inches in thickness. It is typically medium acid to neutral, but in many places it is mildly alkaline in the lower part of the B horizon. The Ap horizon is very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2) and ranges from 7 to 9 inches in thickness. The B horizon is brown (10YR 4/3–5/3), or yellowish brown (10YR 5/4–5/6). Low-chroma mottles occur just below the Ap horizon. The weighted textural class of the B horizon is heavy loam or sandy clay loam. In some places the B horizon has strata of silt loam, sandy loam, fine sandy loam, or light loam. A distinguishing feature of these soils is the stratification of medium and coarse-textured sediment in the B horizon, the C horizon, or both, above a depth of 40 inches.

The Kibbie soils in this survey area are more alkaline in the lower part of the B horizon than is defined as the range for the series.

The somewhat poorly drained Kibbie soils are in a drainage sequence with the well-drained Sisson soils and the poorly drained Colwood soils. They also occur with Yahara soils. They contain more clay between a depth of 10 and 40 inches than Yahara soils and have a slightly thinner A horizon.

Kibbie fine sandy loam, 0 to 4 percent slopes (KbA).—Areas of this soil are mostly long and narrow and occur on valley terraces along drainageways or on terraces bordering depressions. Some larger, irregularly shaped areas are on broad flood plains and lake plains. This soil is typically adjacent to Colwood soils.

Included with this soil in mapping are some small areas of Colwood fine sandy loam, 0 to 3 percent slopes, and Yahara fine sandy loam, 0 to 4 percent slopes. Also included are some small sand and wet spots, which are indicated by spot symbols on the soil map; areas where the surface layer is silt loam or loam; areas that are better drained; small areas where the subsoil is silty; areas where a sandy substratum or loamy glacial till is at a depth of 40 to 60 inches; and a few areas where the surface layer is 10 to 15 inches thick.

The hazard of erosion is slight where slopes are 2 to 4 percent. Wetness is the major limitation. Runoff is slow. Draining the soil is difficult because if saturated, the silt and sand tend to flow easily.

If adequately drained, this soil is well suited to the crops commonly grown in the survey area. Most of the acreage is cultivated. Undrained areas are suited to pasture or woodland. Capability unit IIw-2; woodland group 1o1; wildlife group 5a.

Knowles Series

The Knowles series consists of well-drained silty soils underlain at a depth of 20 to 40 inches by limestone. These soils formed in 18 to 30 inches of silt and the underlying loamy glacial till. They occur on silt-covered till plains. The native vegetation was mixed deciduous forest. Slopes are typically 2 to 12 percent, but range to 20 percent.

In a representative profile the surface layer is very dark grayish-brown silt loam about 8 inches thick. The subsurface layer is yellowish-brown silt loam about 4 inches thick. The subsoil is about 27 inches thick. The upper 11 inches is dark yellowish-brown, firm silty clay loam; the next 6 inches is dark-brown, firm silty clay loam; the next 6 inches is dark-brown, firm clay loam; and the lower 4 inches is dark-brown, friable sandy clay loam. Limestone is at a depth of about 39 inches.

Permeability is moderate. Available water capacity and fertility are medium. The limestone bedrock within 40 inches of the surface restricts many uses of these soils (fig. 11).

Most of the acreage is cultivated. Areas of Knowles soils are a good source of crushed limestone.

Representative profile of Knowles silt loam, 2 to 6 percent slopes, in an alfalfa field, 600 feet north and 270 feet west of the southeast corner of sec. 16, T. 10 N., R. 12 E.

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; weak, very fine, granular structure; very friable; common fine roots; neutral; abrupt, smooth boundary.

A2—8 to 12 inches, yellowish-brown (10YR 5/4) silt loam; moderate, very fine, subangular blocky structure; friable; common fine roots; neutral; clear, wavy boundary.

B21t—12 to 23 inches, dark yellowish-brown (10YR 4/4) silty clay loam; moderate, very fine, subangular blocky structure; firm; common fine roots; common thin clay films; medium acid; clear, wavy boundary.

B22t—23 to 29 inches, dark-brown (10YR 4/3) silty clay loam; moderate, very fine, angular blocky struc-

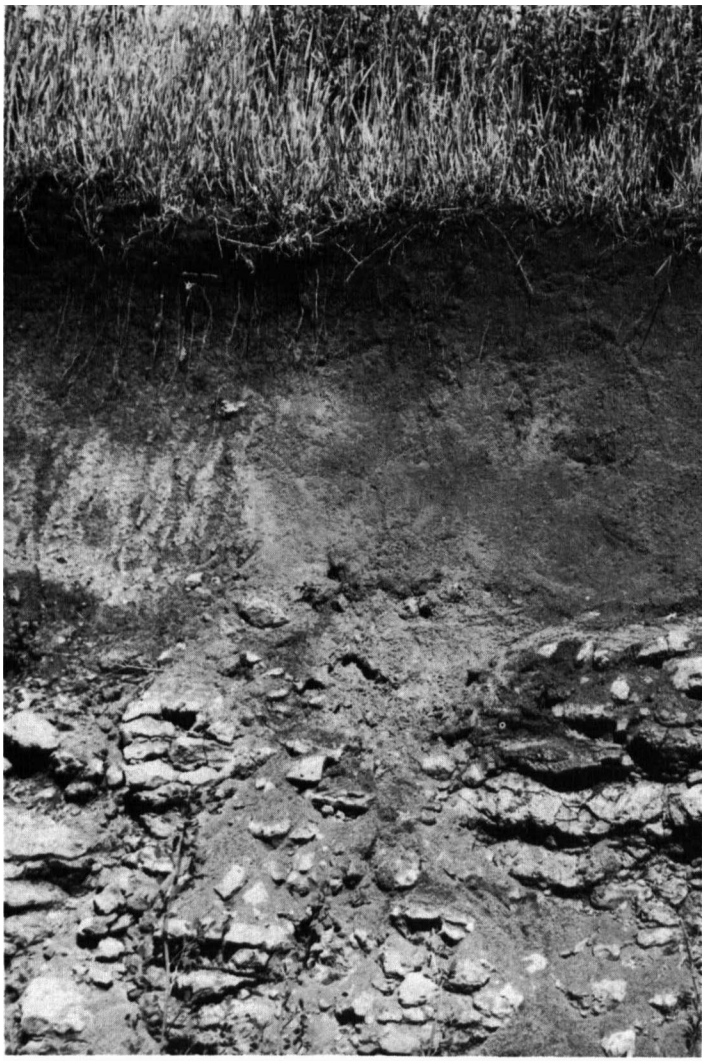

Figure 11.—Profile of Knowles soil. The underlying limestone limits the soil for many uses.

ture; firm; few fine roots; continuous thin clay films on faces of peds; medium acid; clear, wavy boundary.

IIB23t—29 to 35 inches, dark-brown (10YR 4/3) clay loam; weak, fine, subangular blocky structure; firm; few fine roots; many thin clay films on faces of peds; about 4 percent gravel; slightly acid; clear, wavy boundary.

IIB3t—35 to 39 inches, dark-brown (7.5YR 4/4) sandy clay loam; weak, medium, subangular blocky structure; friable; few fine roots; many thin clay bridges between mineral grains; about 14 percent gravel; mildly alkaline; abrupt, wavy boundary.

R—39 to 60 inches, limestone bedrock.

Thickness of the solum and depth to bedrock are typically 30 to 40 inches but range from 20 to 40 inches. The depth to the till layer ranges from 18 to 30 inches. The Ap horizon ranges from very dark grayish brown (10YR 3/2) to dark brown (10YR 4/3) in color and from 6 to 9 inches in thickness. Where it occurs, the A1 horizon is very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2) and ranges from 2 to 5 inches in thickness. The A2 horizon ranges from dark grayish brown (10YR 4/2) to light yellowish brown (10YR 6/4) in color and from 2 to 5 inches in thickness. The B horizon is mainly heavy silt loam or silty clay loam. The IIB horizon formed in loamy till and is dark-brown (7.5YR 4/4 and 10YR 4/3) or dark yellowish-brown (10YR 3/4 to 4/4) clay loam, loam, or sandy clay loam. The upper 20 inches of the B horizon is less than 15 percent sand coarser than very fine.

Knowles soils occur with Dodge and St. Charles soils and are similar to Baraboo and Channahon soils. Unlike Dodge and St. Charles soils, they are underlain by bedrock within a depth of 40 inches. They are underlain by limestone, whereas Baraboo soils are underlain by quartzite. They are deeper over limestone than Channahon soils.

Knowles silt loam, 2 to 6 percent slopes (KnB).—This soil is in irregularly shaped areas on rises and the crests of ridges on the till plain. Areas are commonly 20 to 40 acres in size. This soil has the profile described as representative of the Knowles series.

Included with this soil in mapping are a few small areas of Channahon silt loam, 2 to 6 percent slopes. Also included are a few areas where the lower part of the subsoil is mottled, a few nearly level areas, areas where part of the surface layer has been lost through erosion, and areas where the bedrock is at a depth of more than 40 inches, places where the silt mantle is less than 18 inches thick, and a few quarries, which are indicated by spot symbols on the soil map.

Runoff is slow. The erosion hazard is slight. Bedrock restricts roots and also restricts the use of this soil for septic tank filter fields.

This soil is well suited to cultivated crops. Most of the acreage is cropped to corn, small grain, or legumes. Capability unit IIe–2; woodland group 2o1; wildlife group 1.

Knowles silt loam, 6 to 12 percent slopes, eroded (KnC2).—This soil is on rises and along ridges on the till plain. Areas are irregularly shaped or long and range up to 80 acres in size. This soil has a profile similar to the one described as representative of the series, but depth to bedrock is commonly 25 to 35 inches and the subsurface layer has been incorporated into the plow layer in most places.

Included with this soil in mapping are a few areas of Channahon silt loam, 6 to 12 percent slopes, eroded; areas where the silt mantle is less than 18 inches thick; and few areas where bedrock is at a depth of more than 40 inches. Also included are some quarries, which are indicated by spot symbols on the soil map.

Runoff is medium. The erosion hazard is moderate. Bedrock restricts roots and also restricts the use of this soil for septic tank filter fields.

Most of the acreage is cultivated. Some is forested. Corn and alfalfa are the chief crops. Capability unit IIIe–2; woodland group 2o1; wildlife group 1.

Knowles silt loam, 12 to 20 percent slopes, eroded (KnD2).—This soil is in long, narrow areas along ridges on the till plain. Areas are commonly less than 20 acres in size. In cultivated areas, most of the original surface layer has been lost through erosion and the rest has been mixed with the subsurface layer and part of the subsoil through tillage. In forested areas the surface layer is very dark brown and is 2 or 3 inches thick, and the subsurface layer is brown and is 2 to 5 inches thick. Bedrock is commonly at a depth of 20 to 30 inches.

Included with this soil in mapping are a few small areas of Channahon silt loam, 12 to 30 percent slopes, eroded; areas where the silt mantle is less than 18

inches thick; and areas where bedrock is at a depth of more than 40 inches. Also included, and indicated by spot symbols on the soil map, are severely eroded areas where the subsoil is exposed at the surface, and a few gullies, outcrops of bedrock, and quarries.

Runoff is rapid. The erosion hazard is severe. Bedrock restricts roots.

This soil is poorly suited to cultivated crops. Most of the acreage is used as pasture or woodland. Many areas were cultivated at one time. Capability unit IVe–2; woodland group 2r2; wildlife group 1.

Lapeer Series

The Lapeer series consists of well-drained loamy soils. These soils formed in calcareous sandy loam glacial till. They are on moraines, drumlins, and till plains. Stones and boulders are scattered on the surface in many areas. Slopes are commonly 2 to 12 percent, but range to 30 percent. The native vegetation was mixed deciduous forest.

In a representative profile the surface layer is very dark grayish-brown fine sandy loam about 8 inches thick. The subsoil is about 25 inches thick. The upper 3 inches is dark-brown fine sandy loam; the next 13 inches is dark-brown heavy sandy loam; and the lower 9 inches is dark-brown heavy sandy loam. The substratum is yellowish-brown, moderately alkaline gravelly light sandy loam.

Permeability, available water capacity, and fertility are medium.

Lapeer soils are cropped to corn, small grain, and legumes in many places. The steeper slopes are in permanent pasture or woodland.

Representative profile of Lapeer fine sandy loam, 6 to 12 percent slopes, eroded, 240 feet south and 270 feet west of the northeast corner of NW¼SE¼ sec. 2, T. 10 N., R. 8 E.

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) fine sandy loam, light brownish gray (10YR 6/2) dry; weak, fine, subangular blocky structure; very friable; many fine roots; slightly acid; abrupt, smooth boundary.

B1—8 to 9 inches, dark-brown (10YR 4/3) fine sandy loam; weak, medium, subangular blocky structure; very friable; common fine roots; about 10 percent gravel; slightly acid; clear, wavy boundary.

B21t—9 to 12 inches, dark-brown (7.5YR 4/4) heavy sandy loam; weak, fine, subangular blocky structure; very friable; common fine roots; about 10 percent gravel; few thin clay films on faces of peds; slightly acid; clear, wavy boundary.

B22t—12 to 22 inches, dark-brown (7.5YR 4/4) heavy sandy loam; moderate, fine, subangular blocky structure; friable; few fine roots; about 10 percent gravel; many thin clay films on faces of peds; slightly acid; clear, wavy boundary.

B3t—22 to 31 inches, dark-brown (7.5YR 4/4) sandy loam; weak, medium, subangular blocky structure; friable; few fine roots; about 10 percent gravel; many thin clay bridges between mineral grains; slightly acid; clear, wavy boundary.

C—31 to 60 inches, yellowish-brown (10YR 5/4) gravelly light sandy loam; massive; very friable; about 25 percent gravel; moderately alkaline; slight effervescence.

The solum ranges from 24 to 40 inches in thickness. The Ap horizon is very dark grayish brown (10YR 3/2) to dark brown (10YR 4/3) and ranges from 6 to 9 inches in thickness. Where it occurs, the A1 horizon is black (10YR 2/1) to very dark grayish brown (10YR 3/2) and is less than 5 inches thick. The B1 horizon is fine sandy loam or sandy loam. The Bt horizon is dark brown (7.5YR 4/4) or dark yellowish brown (10YR 4/4). The weighted average texture is heavy sandy loam, but individual subhorizons are light sandy clay loam or sandy loam. The average clay content ranges from about 15 to 18 percent. The B horizon is commonly slightly acid or medium acid, but it ranges to mildly alkaline in the lower part. The C horizon is light sandy loam or sandy loam glacial till. In many places it is gravelly.

Lapeer soils occur with McHenry, Military, Rotamer, and Wyocena soils. They have more sand and less silt in the upper part of the B horizon than McHenry soils. Unlike Military soils, they are not underlain by bedrock within a depth of 40 inches. Their solum is thicker than that of Rotamer soils. Their B horizon is more clayey than that of Wyocena soils.

Lapeer fine sandy loam, 2 to 6 percent slopes (LaB).—This soil is in irregularly shaped or broad and long areas on slight rises on the till plain. Areas are commonly 40 to 80 acres in size, but range up to several hundred acres. The profile of this soil is similar to the one described as representative of the series, but the surface layer is 6 to 9 inches thick and the subsoil extends to a depth of 32 to 40 inches.

Included with this soil in mapping are a few areas of Wyocena sandy loam, 2 to 6 percent slopes; a few areas where sandstone bedrock is at a depth of 40 to 60 inches; areas where the substratum is loamy sand glacial till; areas where the subsoil extends to a depth of more than 40 inches; nearly level areas; and areas where the surface layer is loamy fine sand or coarser. Also included are some sand spots, which are indicated by spot symbols on the soil map, and adjacent to large areas of silty soils are many areas where the surface layer is loam or silt loam.

Runoff is slow. The erosion hazard is slight.

This soil has few limitations. It is well suited to the crops commonly grown in the survey area, and it is also well suited to woodland. Most of the acreage is cultivated. In some places, stones interfere with tillage. Capability unit IIe–1; woodland group 3o1; wildlife group 1.

Lapeer fine sandy loam, 6 to 12 percent slopes, eroded (LaC2).—This soil is in long areas on rises and along ridges and drumlins on the till plain. Areas range from 30 to 60 acres in size. The soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Wyocena sandy loam, 6 to 12 percent slopes, eroded; a few small areas where sandstone bedrock is at a depth of 40 to 60 inches; areas where the subsoil extends to a depth of more than 40 inches; areas where the substratum is loamy sand till; and areas where the surface layer is loamy fine sand. Also included are many areas, adjacent to large areas of silty soils, where the surface layer is loam or silt loam.

Runoff is medium. The erosion hazard is moderate.

Most of the acreage is cultivated. Some is used as pasture and woodland (fig. 12). Corn, small grain, or legumes are the chief crops. In places, stones interfere with tillage. Capability unit IIIe–1; woodland group 3o1; wildlife group 1.

Lapeer fine sandy loam, 12 to 20 percent slopes, eroded (LaD2).—This soil is in long, narrow areas along ridges

Figure 12.—**Woodlot on a sloping Lapeer soil. Many areas formerly wooded are now cultivated.**

and on the sides of drumlins on the till plain. Areas are less than 40 acres in size. In forested areas the surface layer is 2 to 4 inches thick, and the subsurface layer is 3 to 8 inches thick. In cultivated areas, the profile is similar to that described as representative of the series.

Included with this soil in mapping are small areas of Wyocena sandy loam, 12 to 20 percent slopes, eroded; a few small areas where sandstone bedrock is at a depth of 40 to 60 inches, areas where the subsoil extends to a depth of more than 40 inches, areas where the substratum is loamy sand till; areas where the surface layer is loamy fine sand; and many areas adjacent to large areas of silty soils, where the surface layer is loam or silt loam. Also included are a few severely eroded spots and gullies, which are indicated by spot symbols on the soil map.

Runoff is rapid. The erosion hazard is severe.

This soil is poorly suited to cultivated crops. Most of the acreage is used as pasture or woodland, or for growing hay. Capability unit IVe–1; woodland group 3r2; wildlife group 1.

Lapeer fine sandy loam, 20 to 30 percent slopes, eroded (LaE2).—This soil is in long areas along ridges and on drumlins on the till plain. Areas are less than 50 acres in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is 1 or 2 inches thick, the subsurface layer is 2 to 4 inches thick, and the surface layer and subsoil combined is a few inches thinner.

Included with this soil in mapping are small areas of Wyocena loamy sand, 20 to 45 percent slopes; a few small areas where the substratum is loamy sand till; areas where sandstone bedrock is at a depth of 40 to 60 inches; and areas where the surface layer and subsoil combined is either less than 24 inches or more than 40 inches thick. Also included are areas that are very steep, areas that are only slightly eroded, many large areas where the surface layer is loam or silt loam, and many gullies, which are indicated by spot symbols on the soil map.

Runoff is very rapid. The erosion hazard is very severe.

This soil is poorly suited to crops. Most of the acreage is forested or pastured, or both. Capability unit VIe–1; woodland group 3r2; wildlife group 1.

Lorenzo Series

The Lorenzo series consists of well-drained loamy soils underlain at a depth of about 12 to 24 inches by

calcarerous stratified sand and gravel outwash. These soils are on kames, eskers, valley trains, moraines, and outwash plains. Gravel pits are common and are shown by spot symbols on the maps. Slopes are commonly 2 to 12 percent but range to 20 percent. The native vegetation was dominantly prairie grasses.

In a representative profile the surface layer is very dark grayish-brown loam about 8 inches thick. The subsoil is about 10 inches thick. The upper 7 inches is dark-brown, friable sandy clay loam, and the lower 3 inches is dark-brown, firm cobbly heavy sandy clay loam. The substratum is yellowish-brown, strongly effervescent, stratified sand and gravel and some cobblestones.

These soils tend to be droughty during dry seasons. Permeability is moderate to a depth of about 18 inches and rapid or very rapid below that depth. Available water capacity is low. Fertility is medium. Roots are limited by the sand and gravel substratum.

These soils are an important source of sand and gravel in this survey area (fig. 13). Most of the acreage is cultivated.

Representative profile of Lorenzo loam, 2 to 6 percent slopes, in a cornfield 95 feet east and 105 feet north of the southwest corner of SE¼NW¼ sec. 18, T. 12 N., R. 10 E.

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak, medium, subangular blocky structure; very friable; common fine roots; slightly acid; abrupt, smooth boundary.

B21t—8 to 15 inches, dark-brown (7.5YR 4/4) sandy clay loam; moderate, medium, subangular blocky structure; friable; common fine roots; about 5 percent gravel; common thin clay films on faces of peds; neutral; clear, wavy boundary.

IIB22t—15 to 18 inches, dark-brown (7.5YR 4/4) cobbly heavy sandy clay loam; moderate, medium, subangular blocky structure; firm; many, moderately thick, dark-brown (7.5YR 3/2) clay films on faces of peds; about 40 percent cobblestones; mildly alkaline; abrupt, wavy boundary.

IIC—18 to 60 inches, yellowish-brown (10YR 5/4) stratified sand and gravel; single grained; loose; about 10 percent cobblestones; strong effervescence.

The solum ranges from 12 to 24 inches in thickness. It is commonly medium acid to neutral and ranges to moderately alkaline in the lower part. The A horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2) in color and from 4 to 9 inches in thickness. Some places have a dark-brown (10YR 3/3) A3 horizon, 1 to 3 inches thick, that is loam or heavy loam. The B2t horizon is dark brown (7.5YR 4/4) or dark yellowish brown (10YR 4/4–4/4). In some places, the IIB horizon is dark brown (7.5YR 3/2). The B horizon is commonly sandy clay loam or clay loam and, in some places, is as much as 40 percent gravel or coarser fragments. The IIC horizon is as much as 30 percent cobblestones.

Lorenzo soils occur with Dresden and Rodman soils. They have a thinner solum than Dresden soils and thicker solum than Rodman soils.

Lorenzo loam, 2 to 6 percent slopes (LoB).—Irregularly shaped areas of this soil are slight rises on the outwash plain. Areas are commonly 30 to 50 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Dresden loam, 1 to 6 percent slopes, and Boyer fine sandy loam, 2 to 6 percent slopes. Also included are a few small areas where the surface layer is sandy loam or silt loam; areas where the substratum is mostly sand; nearly level areas; and a few small depressions, which are shown by spot symbols on the soil map. In a few convex areas, part of the surface layer has been lost through erosion.

Figure 13.—**Profile of Lorenzo soil. The underlying material is a good source of sand and gravel.**

Runoff is slow. The erosion hazard is slight.

Most of the acreage is cultivated. Corn, small grain, and alfalfa are commonly grown. Growth of crops is limited by low available water capacity and a shallow root zone. The substratum is a good source of sand and gravel. Capability unit IIIe–3; woodland group 3dl; wildlife group 3.

Lorenzo loam, 6 to 12 percent slopes, eroded (LoC2).—Irregularly shaped areas of this soil are on the sides

and crests of rises on the outwash plain near Dresden and Rodman soils. Areas are commonly 10 to 20 acres in size. This soil has a profile similar to the one described as representative of the series, but the surface layer is 1 to 3 inches thinner.

Included with this soil in mapping are small areas of Dresden loam, 6 to 12 percent slopes, eroded, and Rodman gravelly loam, 2 to 12 percent slopes. Also included are some small depressions, which are indicated by spot symbols on the soil map; a few small areas where the surface layer is sandy loam or silt loam, areas where the substratum is mostly sand, areas where the surface layer is lighter colored, and areas where the subsoil is dominantly heavy sandy loam.

Runoff is medium. The erosion hazard is moderate.

This soil is generally poorly suited to intensive cultivation. Most of the acreage is cropped to corn or alfalfa. Some is pastured. It is a good source of sand and gravel. Capability unit IVe-3; woodland group 3dl; wildlife group 3.

Lorenzo loam, 12 to 20 percent slopes, eroded (LoD2).—Small, irregularly shaped or long areas of this soil are on knolls and ridges on the outwash plain. Areas are commonly 3 to 10 acres in size. The surface layer is commonly 4 to 7 inches thick. On some of the more eroded spots, material from the subsoil is exposed at the surface.

Included with this soil in mapping are small areas of Dresden loam, 12 to 20 percent slopes, eroded; Rodman gravelly loam, 12 to 20 percent slopes; and Boyer loamy sand, 12 to 30 percent slopes, eroded. Also included are a few small areas where the surface layer is sandy loam or silt loam, areas where the substratum is mostly medium sand, and areas where the surface layer is lighter colored.

Runoff is rapid. The erosion hazard is severe.

This soil is cropped to alfalfa or used as pasture. It is poorly suited to cultivated crops, but it is a good source of sand and gravel. Capability unit VIe-3; woodland group 3d2; wildlife group 3.

Marcellon Series

The Marcellon series consists of somewhat poorly drained loamy soils. These soils formed in calcareous loamy glacial till. They are on toe slopes of drumlins and till uplands adjacent to bottom land. In some places, scattered stones are on the surface. These places are indicated by spot symbols on the soil map. The native vegetation was grasses and hardwoods.

In a representative profile the surface layer is loam about 14 inches thick. The upper 9 inches is very dark brown, and the lower 5 inches is very dark grayish brown. Just below the surface layer is a transitional layer of dark-brown loam about 4 inches thick. The subsoil is mottled, dark yellowish-brown, friable loam about 18 inches thick. The substratum is mixed grayish-brown and brown, mottled fine sandy loam. The subsoil and substratum contain some fine gravel.

These soils are saturated at a depth of 1 to 3 feet during wet seasons. Permeability is moderate. Available water capacity is medium, and fertility is high.

Most of the acreage is used for crops or pasture. Many pastured areas have some stones on the surface.

Representative profile of Marcellon loam, 1 to 6 percent slopes, 530 feet east of Berkvam road and 557 feet south of King road in NE¼NE¼ sec. 30, T. 11 N., R. 11 E.

Ap—0 to 5 inches, very dark brown (10YR 2/2) loam; moderate, fine and medium, subangular blocky structure; friable, slightly sticky, slightly plastic; many fine roots; slightly acid; abrupt, smooth boundary.

A12—5 to 9 inches, very dark brown (10YR 2/2) loam; weak, coarse, subangular blocky structure; friable, slightly sticky, slightly plastic; common fine roots; slightly acid; clear, wavy boundary.

A13—9 to 14 inches, very dark grayish-brown (10YR 3/2) loam; weak, medium, subangular blocky structure; friable, slightly sticky, slightly plastic; common fine roots; few worm casts; slightly acid; clear, wavy boundary.

A3—14 to 18 inches, dark-brown (10YR 3/3) loam; moderate, fine, subangular blocky structure; friable, sticky, plastic; few fine roots; slightly acid; clear, wavy boundary.

B21—18 to 25 inches, dark yellowish-brown (10YR 4/4) loam; common, fine, distinct, dark grayish-brown (10YR 4/2), grayish-brown (10YR 5/2), and yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; friable, sticky, slightly plastic; few fine roots; 3 percent fine gravel; neutral; clear, wavy boundary.

B22t—25 to 30 inches, dark yellowish-brown (10YR 4/4) heavy loam; common, fine, distinct, dark grayish-brown (10YR 4/2), grayish-brown (10YR 5/2), and yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; friable, sticky, slightly plastic; few fine roots; thin patchy clay films on faces of peds; 3 percent fine gravel; neutral; clear, wavy boundary.

B3—30 to 36 inches, dark yellowish-brown (10YR 4/4) loam; many, medium, distinct, dark grayish-brown (10YR 4/2) and yellowish-brown (10YR 5/6) mottles; weak, medium and coarse, subangular blocky structure; friable, sticky, slightly plastic; few fine roots; thin patchy clay films on faces of peds; 8 percent fine gravel; neutral; clear, wavy boundary.

C—36 to 60 inches, mixed grayish-brown (10YR 5/2) and brown (10YR 5/3) fine sandy loam; common, fine, faint, light brownish-gray (10YR 6/2) mottles, common, fine, distinct, reddish-gray (5YR 5/2) and reddish-brown (5YR 5/3) mottles, and common, fine, prominent, yellowish-brown (10YR 5/6) mottles; massive; friable, slightly sticky, slightly plastic; 3 percent fine gravel; slight effervescence.

The solum is typically 24 to 36 inches thick but ranges from 20 to 40 inches. It is slightly acid or medium acid in the upper part and slightly acid to moderately alkaline in the lower part. The A horizon is 10 to 20 inches thick. The B horizon is 10 to 27 inches thick and ranges from dark brown (10YR 4/3) to yellowish brown (10YR 5/4). The B2 horizon is heavy sandy loam, sandy clay loam, clay loam, or loam. The B3 horizon is loam, fine sandy loam, or sandy loam. Common or many low-chroma and high-chroma mottles are throughout the B horizon. The C horizon is fine sandy loam, sandy loam, or heavy sandy loam.

The somewhat poorly drained Marcellon soils form a drainage sequence with the well-drained Griswold soils and the poorly drained Barry soils. Unlike Griswold soils, they are mottled throughout the B horizon. They are saturated during wet periods, whereas Barry soils are saturated throuhout most of the year.

Marcellon loam, 1 to 6 percent slopes (MaB).—This soil commonly occupies long, narrow areas between till uplands and bottom land. Areas are typically 10 to 30 acres in size.

Included with this soil in mapping are some areas, adjacent to silty soils, that have a surface layer of silt loam. Also included are some wet spots, which are indicated by spot symbols on the soil map, and small areas where the substratum is sand and gravel and the surface layer is less than 10 inches thick.

Runoff is slow. The erosion hazard is slight. Wetness is the major limitation.

If adequately drained, this soil is well suited to the crops commonly grown in the survey area. It is used mainly for crops and pasture. In some places, the number of stones on the surface makes tillage impractical. Capability unit IIw-2; woodland group 2o1; wildlife group 5a.

Marsh

Marsh (Mb) occurs as scattered small areas throughout the county. It is nearly level mineral and organic soil material that is covered with water throughout most of the year. Larger areas are adjacent to lakes and streams. The plant cover is mainly cattails, rushes, sedges, and other water-tolerant plants. Included in mapping are small bodies of open water typically surrounded by cattails (fig. 14).

Marsh has a dark-colored surface layer that is underlain by grayish material. The reaction is generally neutral to moderately alkaline.

Marsh provides wildlife habitat, but is not suited to any of the crops commonly grown in the county. Drainage is not economically feasible. Capability unit VIIIw-15; woodland group not classified; wildlife group 6.

Marshan Series

The Marshan series consists of nearly level, poorly drained loamy soils. These soils formed in 24 to 38 inches of loamy sediment underlain by sandy sediment. They are on low terraces and flood plains. The native vegetation was water-tolerant grasses, sedges, and willows (fig. 15).

In a representative profile the surface layer is black loam about 10 inches thick. The subsoil is about 14 inches thick. The upper 4 inches is olive-gray, friable light sandy clay loam. The lower 10 inches is black, friable sandy clay loam. The substratum is grayish-brown, neutral sand.

These soils are subject to occasional flooding. Water ponds in spring and after heavy rains. Permeability is moderate in the loamy sediment and rapid in the under-

Figure 14.—**Open water, cattails, and a border of trees in a typical area of Marsh near Otsego.**

Figure 15.—Native vegetation of willows, sedges, and water-tolerant grasses on Marshan loam.

lying sandy sediment. Available water capacity and fertility are medium. Ground water is at or near the surface throughout most of the year.

Undrained areas of Marshan soils are used for pasture or woodland. Drained areas are planted to corn, soybeans, and small grain.

Representative profile of Marshan loam (0 to 2 percent slopes), 455 feet east and 212 feet north of the southwest corner of NE¼ sec. 28, T. 13 N., R. 7 E.

Ap—0 to 10 inches, black (10YR 2/1) loam; few, fine and medium, distinct and prominent, dark-gray (10YR 4/1) and dark-brown (7.5YR 4/4) mottles; moderate, fine, subangular blocky structure; friable, slightly sticky, slightly plastic; common fine roots; slightly acid; abrupt, smooth boundary.

B1g—10 to 14 inches, olive-gray (5Y 4/2) light sandy clay loam; few black (5Y 1/1) bands, 2 to 5 millimeters in diameter; many, fine, prominent, strong-brown (7.5YR 5/6) mottles and few, medium, distinct, gray (N 5/0) mottles; weak, medium and coarse, subangular blocky structure; friable, slightly sticky, plastic; common fine roots; slightly acid; clear, wavy boundary.

B2g—14 to 24 inches, black (5Y 2/1) sandy clay loam; few, medium, distinct, dark-gray (N 4/0) mottles and common, medium, prominent, yellowish-red (5YR 4/8) and strong-brown (7.5YR 5/6) mottles; weak, coarse, subangular blocky structure; friable, slightly sticky, plastic; common fine roots; slightly acid, abrupt, wavy boundary.

IIC—24 to 60 inches, grayish-brown (10YR 5/2) sand; single grained; loose; few fine roots in upper 3 inches; common, medium, distinct, brown (7.5YR 4/4) concretions in upper 6 inches; small pockets of moderate, fine, angular blocky clay loam just below concretions; neutral.

The solum is typically 24 to 30 inches thick, but ranges to 38 inches. It is medium acid to neutral in reaction. The A horizon ranges from 10 to 18 inches in thickness and is black (N 2/0 or 10YR 2/1 to 5Y 2/1). The B horizon has hues of 5Y or 2.5Y and chroma of 1 or 2. It is loam, heavy loam, light sandy clay loam, sandy clay loam, or clay loam. The IIC horizon typically is medium or coarse sand, but in some places it is fine sand or very coarse sand.

The Marshan soils in this survey area have a higher content of sand in the B horizon than is defined as the range for the series.

Marshan soils occur with Granby soils and with Alluvial land, loamy, wet. They contain more clay and less sand than Granby soils. In contrast with Alluvial land, loamy, wet, they have well defined horizons and do not have the variable stratification of textures typical of Alluvial land.

Marshan loam (0 to 2 percent slopes) (Mc).—This soil is on broad flood plains and terraces. Large areas, ranging up to several hundred acres, are long and broad and oriented to the flow of the river.

Included with this soil in mapping are small areas of Colwood fine sandy loam, 0 to 3 percent slopes. Also included are a few small areas where the surface layer is muck, sandy loam, or silt loam; small areas where the subsoil is sandy loam or silty clay loam; and a few spots of Marsh, which are indicated by spot symbols on the soil map. In few places this soil is buried by as much as 15 inches of recent alluvial sediment.

Dugout ponds and deep drainage ditches are difficult to establish in this soil because the sandy substratum tends to flow easily if saturated. Runoff is very slow to ponded. There is little or no erosion hazard. Wetness, occasional flooding, and ponding are the major limitations.

If adequately drained, this soil is well suited to the crops commonly grown in the survey area. Undrained areas are suited to pasture or woodland. Capability unit IIw–1; woodland group 4w5; wildlife group 5b.

McHenry Series

The McHenry series consists of well-drained silty soils that formed in 15 to 30 inches of silty sediment and the underlying calcareous sandy loam till. These soils are on silt-covered till plains. Slopes range from 2 to 20 percent. The native vegetation was mixed deciduous forest.

In a representative profile the surface layer is dark grayish-brown silt loam about 8 inches thick. The subsoil is about 29 inches thick. The upper 11 inches is dark yellowish-brown, friable light silty clay loam; the next 10 inches is dark-brown, friable sandy clay loam, and the lower 8 inches is dark-brown, very friable heavy sandy loam. The substratum is yellowish-brown, slightly effervescent gravelly light sandy loam.

Permeability is moderate. Available water capacity is medium. Fertility is high.

Most areas of these soils are cultivated.

Representative profile of McHenry silt loam, 2 to 6 percent slopes, eroded, 80 feet east and 396 feet north of the southwest corner of SE¼NE¼ sec. 9, T. 11 N., R. 8 E.

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak, very fine, subangular blocky structure; friable; many fine roots; neutral; abrupt, smooth boundary.

B21t—8 to 19 inches, dark yellowish-brown (10YR 4/4) light silty clay loam; moderate, fine, angular and subangular blocky structure; friable; common fine roots; continuous thin clay films on faces of peds; slightly acid; clear, wavy boundary.

IIB22t—19 to 29 inches, dark-brown (7.5YR 4/4) sandy clay loam; moderate, medium, subangular blocky structure; friable; few fine roots; many thin clay films on faces of peds; about 5 percent gravel; slightly acid; gradual, wavy boundary.

IIB3t—29 to 37 inches, dark-brown (7.5YR 4/4) heavy sandy loam; weak, medium, subangular blocky structure; very friable; few fine roots; common thin clay bridges between mineral grains; about 6 percent gravel; neutral; clear, wavy boundary.

IIC—37 to 60 inches, yellowish-brown (10YR 5/4) gravelly light sandy loam; massive; very friable; about 20 percent gravel; slightly effervescent.

The solum is commonly 30 to 40 inches thick, but ranges from 24 to about 50 inches. Depth to the till material is commonly 15 to 22 inches but ranges to 30 inches. The Ap horizon is very dark grayish brown (10YR 3/2), dark grayish brown (10YR 4/2), or dark brown (10YR 3/3–4/3). The B horizon is dark-brown (10YR 4/3) to yellowish-brown (10YR 5/4) light silty clay loam, heavy silt loam, or silty clay loam. The IIB horizon is dark brown (7.5YR 4/4) or dark yellowish brown (10YR 4/4). The lower part is dominantly sandy loam. The upper 20 inches of the Bt horizon is 18 to 30 percent clay and is 15 percent or more by weight fine sand or coarser particles. Reaction in the B horizon is commonly medium or slightly acid but ranges to mildly alkaline in the lower part. The C horizon is sandy loam or light sandy loam glacial till and is commonly gravelly.

McHenry soils occur with Dodge, St. Charles and Lapeer soils. They contain more sand and less silt in the upper 20 inches of the Bt horizon than Dodge and St. Charles soils. They have more silt and clay and less sand in the upper part of the B horizon than Lapeer soils.

McHenry silt loam, 2 to 6 percent slopes, eroded (MeB2).—This soil is in irregularly shaped or long areas on slight rises on the till plain near Dodge, Lapeer, and St. Charles soils. Areas are commonly 20 to 50 acres in size. This soil has the profile described as representative of the series. In the western part of the survey area, however, it has a thicker surface layer and subsoil than is typical.

Included with this soil in mapping are small areas of Dodge silt loam, 2 to 6 percent slopes, eroded, and Lapeer fine sandy loam, 2 to 6 percent slopes. Also included are a few areas where bedrock is at a depth of 40 to 60 inches, the soil is nearly level, or the substratum is loamy sand till; and areas where the soil is uneroded or only slightly eroded.

Runoff is medium. Erosion is the major limitation. The hazard is moderate in the more sloping areas.

This soil is well suited to the crops commonly grown in the survey area. Most of the acreage is cultivated. Capability unit IIe–1; woodland group 2o1; wildlife group 1.

McHenry silt loam, 6 to 12 percent slopes, eroded (MeC2).—This soil is in broad and long areas along ridges and rises on the till plain. Most areas range from 10 to 40 acres in size. The profile of this soil is similar to the one described as representative of the series, but west of the Wisconsin River, the surface layer and subsoil are thicker.

Included with this soil in mapping are a few small areas of Dodge silt loam, 6 to 12 percent slopes, eroded, and Lapeer fine sandy loam, 6 to 12 percent slopes, eroded. Also included are a few areas where the substratum is loamy sand till, the soil is uneroded or only slightly eroded, or bedrock is at a depth of 40 to 60 inches.

Runoff is medium. The erosion hazard is moderate.

Most of the acreage is cropped to corn, small grain, or hay. Some is in woodland or used as pasture. Capability unit IIIe–1; woodland group 2o1; wildlife group 1.

McHenry silt loam, 12 to 20 percent slopes, eroded (MeD2).—This soil is commonly in long, narrow areas along ridges and on the sides of drumlins and other rises on the till plain. Most areas are less than 20 acres in size. In many places this soil has a profile similar to the one described as representative of the series, but the surface layer and subsoil combined is 26 to 34 inches thick. In forested areas the surface layer is 2 to 5 inches thick, and the subsurface layer is brown and 3 to 8 inches thick.

Included with this soil in mapping are few small areas of Dodge silt loam, 12 to 20 percent slopes, eroded, and Lapeer fine sandy loam, 12 to 20 percent slopes, eroded. Also included are a few areas where the substratum is loamy sand till, areas where slopes range from 20 to 30 percent, areas where most of the surface layer has been lost through erosion, and a few gullies, which are indicated by spot symbols on the soil map.

Runoff is rapid. The erosion hazard is severe. Moderately steep slopes and erosion are the major limitations.

This soil is generally not suited to intensive cultivation. Most of the acreage is cropped to hay or is pastured or forested. Capability unit IVe–1; woodland group 2r2; wildlife group 1.

Military Series

The Military series consists of gently sloping to moderately steep, well-drained loamy soils underlain at a depth of 20 to 40 inches by sandstone. These soils formed in loamy glacial till. They are on the sides and crests of upland ridges. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is black fine sandy loam about 2 inches thick. The subsurface layer is dark grayish-brown fine sandy loam about 1 inch thick. The subsoil is about 22 inches thick. The upper 8 inches is brown, very friable fine sandy loam; the next 5 inches is dark-brown, very friable sandy loam; the next 4 inches is dark-brown, friable light sandy clay loam; and the lower 5 inches is dark-brown, friable sandy clay loam. Sandstone is at a depth of about 25 inches.

Permeability is moderate. Available water capacity is low, and fertility is medium. Roots are limited by bedrock.

Most of the acreage is woodland or pasture. Some of the less sloping areas are in corn or hay.

Representative profile of Military fine sandy loam, 2 to 6 percent slopes, 200 feet north and 820 feet east of the corner of NE¼ sec. 25, T. 13 N., R. 9 E.

A1—0 to 2 inches, black (10YR 2/1) fine sandy loam; weak, fine, subangular blocky structure; very friable; many roots; neutral; abrupt, wavy boundary.

A2—2 to 3 inches, dark grayish-brown (10YR 4/2) fine sandy loam; weak, fine, subangular blocky structure; very friable; many roots; few fine and medium tubular pores; slightly acid; abrupt, wavy boundary.

B1—3 to 11 inches, brown (10YR 4/3) fine sandy loam; weak, coarse, subangular blocky structure; very friable; slightly sticky, slightly plastic; common roots; few fine and medium tubular pores; 4 percent gravel; slightly acid; gradual, wavy boundary.

B21t—11 to 16 inches, dark-brown (7.5YR 4/4) heavy sandy loam; weak, medium, subangular blocky structure; very friable; slightly sticky, slightly plastic; common roots; many fine and common medium tubular pores; 8 percent gravel; clay bridging of sand grains; medium acid; clear, wavy boundary.

B22t—16 to 20 inches, dark-brown (7.5YR 4/4) light sandy clay loam; moderate, fine and medium, subangular blocky structure; friable; slightly sticky, slightly plastic; few roots; common fine and few medium tubular pores; 7 percent gravel; thin, patchy clay films on faces of peds and clay bridging of sand grains; strongly acid; clear, wavy boundary.

B23t—20 to 25 inches, dark-brown (7.5YR 4/4) sandy clay loam; moderate, fine and medium, subangular blocky structure; friable, sticky, slightly plastic; few roots; few fine and medium tubular pores; 7 percent gravel; thin, continuous clay films on faces of peds and clay bridging of sand grains; strongly acid; abrupt, wavy boundary.

R—25 to 60 inches, reddish-gray (5YR 5/2) and reddish-brown (5YR 5/3) sandstone.

Thickness of the solum and depth to bedrock typically range from 24 to 36 inches, but in places range from 20 to 40 inches. The A1 horizon is black (10YR 2/1) or very dark gray (10YR 3/1) and is 1 to 3 inches thick. The A2 horizon, which does not occur in cultivated areas, is 0 to 5 inches thick. The B1 horizon is 3 to 11 inches thick. The B2t horizon is dark-brown (7.5YR 4/4) or dark yellowish-brown (10YR 3/4 to 4/4) heavy sandy loam, loam, light sandy clay loam, or sandy clay loam and is 9 to 30 inches thick. A B3 horizon occurs in some places. It is sandy loam and ranges from 0 to 8 inches in thickness. The sandstone bedrock is variable in color and hardness.

Military soils are near Lapeer and Northfield soils and are similar to Winneshiek soils. Unlike those soils, they are 20 to 40 inches deep over sandstone. Lapeer soils are 60 inches or more deep. Northfield soils are only 10 to 20 inches deep over sandstone, and Winneshiek soils are 20 to 40 inches deep over limestone.

Military fine sandy loam, 2 to 6 percent slopes (MnB).—This soil is in irregularly shaped areas on till plains and on the crests of ridges. Some areas are several hundred acres in size, but most are smaller than 60 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are some small areas, adjacent to silty soils, where the surface layer is silt loam; and areas where bedrock is at a depth of 40 to 60 inches. Also included are small areas of Wyocena fine sandy loam, sandstone substratum, 2 to 6 percent slopes; areas where the subsoil has a lower content of clay; and some areas, indicated by spot symbols on the soil map, where the soil has scattered stones on the surface.

Runoff is slow. The erosion hazard is slight. Bedrock at a depth of 20 to 40 inches restricts many uses.

Most of the acreage is in woodland or pasture. Part of it is cropped to corn or hay. Controlling erosion and clearing stones from the surface are the main management concerns. Tillage is difficult in stony areas. Capability unit IIe–2; woodland group 2o1; wildlife group 1.

Military fine sandy loam, 6 to 12 percent slopes, eroded (MnC2).—This soil is on breaks along sandstone ridges. Areas are long and narrow and generally small. The profile of this soil is similiar to the one described as representative of the series, but the surface layer and subsoil are thinner.

Included with this soil in mapping are small areas of Wyocena fine sandy loam, sandstone substratum, 6 to 12 percent slopes, eroded. Also included are rock outcrop and gullies, both of which are indicated by spot symbols on the soil map; small areas where bedrock is below a depth of 40 inches; and small areas where the surface layer is silt or loamy sand.

Runoff is medium. The erosion is moderate. Bedrock at a depth of 20 to 40 inches restricts some uses.

This soil is commonly wooded or pastured. Part of the acreage is cropped to hay. Capability unit IIIe–2; woodland group 2o1; wildlife group 1.

Military fine sandy loam, 12 to 20 percent slopes, eroded (MnD2).—This soil is on sandstone ridges of glacial uplands. Areas are generally long and narrow and less than 50 acres in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer and subsoil are thinner.

Included with this soil in mapping are small areas that are steeper; areas where the surface layer has more clay; and some sand spots, rock outcrop, and gullies, all of which are indicated by spot symbols on the soil map. Also included are some small areas of Wyocena fine sandy loam, sandstone substratum, 12 to 20 percent slopes, eroded, and Northfield sandy loam, 12 to 30 percent slopes.

Runoff is rapid. The erosion hazard is severe.

This soil is not suited to cultivated crops. Most of the acreage is wooded. Capability unit IVe–2; woodland group 2r2; wildlife group 1.

Morocco Series

The Morocco series consists of somewhat poorly drained soils formed in deep deposits of fine and medium sand. These soils are on outwash plains, broad flood plains, and lake plains. Slopes range from 0 to 3 percent. The native vegetation was mixed hardwoods.

In a representative profile the surface layer is very dark grayish-brown loamy sand about 9 inches thick. The subsoil is mottled yellowish-brown fine and medium sand about 15 inches thick. The substratum is pale-brown, medium acid fine and medium sand.

These soils are saturated at a depth of about 1 to 3 feet for significant periods during wet seasons. Permeability is rapid. Available water capacity and fertility are low. During dry seasons, the soils are droughty and subject to blowing if the plant cover is removed.

Even if adequately drained, these soils are poorly suited to crops. Drained areas are cropped to hay, small grain, soybeans, and some corn. Undrained areas are in pasture or woodland.

Representative profile of Morocco loamy sand, 0 to 3 percent slopes, 200 feet south of county road 0 and 45 feet east of section line in NW¼NW¼ sec. 27, T. 13 N., R. 7 E.

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) loamy sand; weak, medium, subangular blocky structure; very friable; common fine roots; slightly acid; abrupt, smooth boundary.

B2—9 to 14 inches, yellowish-brown (10YR 5/6) fine and medium sand; few, medium, prominent, light-gray (2.5Y 7/2) mottles and common, medium, faint, strong-brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; very friable; few fine roots; medium acid; clear, smooth boundary.

B3—14 to 24 inches, yellowish-brown (10YR 5/6) fine and medium sand; common, medium, prominent, light brownish-gray (2.5Y 6/2) mottles and few, medium, faint, strong-brown (7.5YR 5/8) mottles; single grained; loose; few fine roots; medium acid; gradual, wavy boundary.

C—24 to 60 inches, pale-brown (10YR 6/3) fine and medium sand; many, coarse, faint, light-gray (2.5Y 7/2) mottles and few, fine, prominent, brownish-yellow (10YR 6/8) mottles; single grained; loose; medium acid.

The solum typically ranges from 24 to 35 inches in thickness. It is typically medium acid, but in some places it is strongly acid. The Ap horizon is very dark grayish brown (10YR 3/2) or dark grayish brown (10YR 4/2). The B horizon is highly mottled and is brown (10YR 5/3) or yellowish-brown (10YR 5/4–5/6–5/8) fine and medium sand. The upper part has mottles with chroma of 2 or less. The C horizon is fine and medium sand and is slightly acid or medium acid.

The somewhat poorly drained Morocco soils occur in a drainage sequence with the excessively drained Plainfield soils and the poorly drained Granby soils. The A horizon is thinner and contains less organic matter than that of Granby soils.

Morocco loamy sand, 0 to 3 percent slopes (MoA).—This soil is in glacial lake basins, on slightly convex flood plains, in swales and along drainageways on outwash plains, and on terraces in depressions. Areas are irregularly shaped or long and broad, and many are several hundred acres in size. The larger areas are in lake basins and on flood plains near Granby soils.

Included with this soil in mapping are small areas of Granby loamy sand and Plainfield loamy fine sand, 0 to 2 percent slopes. Also included are areas where a silty or loamy substratum is at a depth of 40 to 60 inches; some areas where thin bands of silt are in the subsoil and substratum; a few areas where the subsoil is loamy sand or loamy fine sand; and some areas on flood plains where the sand, at a depth of about 20 to 30 inches, is weakly cemented by concentrations of what appears to be iron, since the layer is reddish in color.

Runoff is very slow. There is little or no hazard of water erosion. Wetness and low fertility are the major limitations.

This soil is poorly suited to crops. If adequately drained, however, it is cropped to soybeans, hay, small grain, and some corn, Many areas are pastured or wooded. Capability unit IVw-5; woodland group 3w4; wildlife group 5a.

Mt. Carroll Series

The Mt. Carroll series consists of moderately well drained silty soils. These soils formed in silty deposits, which are underlain at a depth of about 45 to 60 inches by stratified deposits of silt and sand. They occur in valleys and basins adjacent to the Wisconsin River. Slopes are typically 0 to 8 percent but range to 20 percent. The native vegetation was grasses and some deciduous trees.

In a representative profile the surface layer is very dark grayish-brown silt loam about 9 inches thick. The subsurface layer is brown silt loam about 3 inches thick. The subsoil is about 36 inches thick. The upper 5 inches is dark yellowish-brown, friable silt loam; the next 18 inches is dark yellowish-brown, friable heavy silt loam; and the lower 13 inches is yellowish-brown, friable silt loam. The upper 8 inches of the substratum is brown, medium acid silt loam. This is underlain by brown, slightly acid, stratified silt and sand.

These soils are saturated at a depth of about 3 to 5 feet for significant periods during wet seasons. Permeability is moderate. Available water capacity and fertility are high.

Most of the acreage is cultivated.

Representative profile of Mt. Carroll silt loam, benches, 2 to 6 percent slopes, in a cornfield 300 feet north and 185 feet west of the southeast corner of SW¼SW¼ sec. 3, T. 11 N., R. 8 E.

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, medium, subangular blocky structure; friable; many fine roots; few very fine tubular pores; neutral; abrupt, smooth boundary.

A2—9 to 12 inches, brown (10YR 5/3) silt loam; weak, medium, platy structure parting to moderate, very fine, subangular blocky; friable; many fine roots; common very fine tubular pores; neutral; clear, wavy boundary.

B21t—12 to 17 inches, dark yellowish-brown (10YR 4/4) silt loam; moderate, fine, subangular blocky structure; friable; common fine roots; common very fine tubular pores; common thin clay films; neutral; clear, wavy boundary.

B22t—17 to 27 inches, dark yellowish-brown (10YR 4/4) heavy silt loam; moderate, fine, subangular blocky structure; friable; common fine roots; common very fine tubular pores; common thin clay films; neutral; gradual, wavy boundary.

B31t—27 to 35 inches, dark yellowish-brown (10YR 4/4) heavy silt loam; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; friable; common fine roots; common very fine tubular pores; few thin clay films; slightly acid; clear, wavy boundary.

B32—35 to 48 inches, yellowish-brown (10YR 5/4) silt loam; few, fine and medium, distinct and faint, strong-brown (7.5YR 5/6) and brown (10YR 5/3) mottles; weak, coarse, subangular blocky structure; friable; few fine roots; few very fine tubular pores; very few thin clay films; slightly acid; clear, wavy boundary.

C1—48 to 56 inches, brown (10YR 5/3) silt loam; common, coarse, faint and prominent, light brownish-gray (2.5Y 6/2) and strong-brown (7.5YR 5/6) mottles; massive; friable; few fine roots; few very fine tubular pores; medium acid; abrupt, wavy boundary.

IIC2—56 to 60 inches, brown (10YR 5/3) stratified silt and sand; common, fine and medium, faint and prominent, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/6) mottles; massive; very friable; slightly acid.

The solum typically ranges from 42 to 60 inches in thickness. A distinguishing feature of these soils is a stratified silt and sand IIC horizon at a depth of 45 to 60 inches. The Ap or A1 horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2) and is 6 to 9 inches thick. The A2 horizon ranges from dark grayish brown (10YR 4/2) to brown (10YR 5/3). The B horizon ranges from dark brown (10YR 4/3) to yellowish brown (10YR 5/4). The clay content ranges from about 18 to 24 percent. The B horizon ranges from medium acid to neutral in reaction.

The Mt. Carroll soils in this survey area are more mottled in the lower part of the B horizon and in the C horizon than is defined as the range for the series.

Mt. Carroll soils occur with Seaton soils, but typically oc-

cupy a lower position on the landscape. Their A horizon is slightly thicker and contains more organic matter than that of Seaton soils. Unlike those soils, they are mottled in the lower part of the B horizon and have a IIC horizon of stratified silt and sand at a depth of about 45 to 60 inches.

Mt. Carroll silt loam, 12 to 20 percent slopes, eroded (MrD2).—This soil is in long and narrow areas along valley sides. Areas are less than 40 acres in size. This soil has a profile similar to the one described as representative of the series, but the surface layer is 5 to 8 inches thick. In many places, the subsurface layer and part of the subsoil have been incorporated into the plow layer.

Included with this soil in mapping are small areas of Seaton silt loam, 12 to 20 percent slopes, eroded; areas where the entire surface layer has been lost through erosion; and a few gullies, which are indicated by spot symbols on the soil map. Also included are small areas where stratified silt and sand is at a depth of less than 45 inches and some areas where sandy loam glacial till is at a depth of less than 60 inches.

Runoff is rapid. The erosion hazard is severe.

This soil is too steep and erodible to be intensively cultivated. It is used mostly for forage plants and is suitable for pasture. Capability unit IVe–1; woodland group 2r2; wildlife group 1.

Mt. Carroll silt loam, benches, 0 to 2 percent slopes (MtA).—This soil is in irregularly shaped areas on low terraces on valley floors and in basins. Areas are commonly 40 to 80 acres in size. This soil has a profile similar to the one described as representative of the series, but the surface layer is black or very dark brown.

Included with this soil in mapping are a few areas of Plano silt loam, 0 to 2 percent slopes. Also included are areas where stratified silt and sand is not within a depth of 60 inches and the silty substratum is very massive or platy at a depth of 45 to 60 inches; and a few wet spots, which are indicated by spot symbols on the soil map.

Runoff is slow or very slow. The erosion hazard is slight. Water is likely to pond on the surface during wet seasons and after a heavy rainfall.

This soil is well suited to intensive cultivation. Most of the acreage is cropped to corn or vegetable crops. The soil is poorly suited as septic tank filter fields. Capability unit I; woodland group 2o1; wildlife group 1.

Mt. Carroll silt loam, benches, 2 to 6 percent slopes (MtB).—This soil is in irregularly shaped or long areas on terraces in valleys and basins. Areas range up to several hundred acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of Plano silt loam, 2 to 6 percent slopes; Seaton silt loam, 2 to 6 percent slopes, eroded; and Mt. Carroll silt loam, benches, 0 to 2 percent slopes. Also included are some areas of eroded soil and some areas where the silty deposits are more than 60 inches thick.

Runoff is slow. The erosion hazard is slight in most areas.

This soil is well suited to intensive cultivation. Most of the acreage is cultivated, and corn is the major crop. Use of this soil as septic tank filter fields is hazardous. Capability unit IIe–1; woodland group 2o1; wildlife group 1.

Mt. Carroll silt loam, benches, 6 to 12 percent slopes, eroded (MtC2).—This soil is commonly in long, narrow areas along valley sides. Areas are 20 to 40 acres in size. In most areas, the surface layer is only 7 or 8 inches thick and is a mixture of the subsurface layer and the original surface layer.

Included with this soil in mapping are a few areas of Seaton silt loam, 6 to 12 percent slopes, eroded, and Plano silt loam, 6 to 12 percent slopes, eroded. Also included are a few small areas where the surface layer is only 5 to 7 inches thick, areas where the silty deposits are less than 45 inches or more than 60 inches thick, and a few gullies, which are indicated by spot symbols on the soil map.

Runoff is medium. The erosion hazard is moderate. Erosion is the major limitation.

Most of the acreage is cultivated. Corn and legumes are commonly grown. Capability unit IIIe–1; woodland group 2o1; wildlife group 1.

Northfield Series

The Northfield series consists of well-drained loamy soils that are only 10 to 20 inches deep over sandstone. These soils formed in loamy glacial till. They occupy the crests and sides of sandstone ridges in the till plain. Slopes are typically 12 to 30 percent, but range from 2 to 30 percent. The native vegetation was a mixture of oaks, juniper, and grasses.

In a representative profile the surface layer is about 1 inch of black sandy loam. The subsurface layer is about 3 inches of dark grayish-brown sandy loam. The subsoil is about 14 inches thick. The upper 5 inches is dark yellowish-brown sandy loam, and the lower 9 inches is dark yellowish-brown sandy clay loam. Sandstone bedrock is at a depth of about 18 inches.

These soils are droughty during dry seasons. Permeability is moderate. Available water capacity is very low. Fertility is medium. The shallowness over sandstone restricts many uses of these soils.

Most of the acreage is forested.

Representative profile of Northfield sandy loam, 12 to 30 percent slopes, in a wooded area 330 feet east and 80 feet south of the northwest corner of SW¼ sec. 18, T. 10 N., R. 8 E.

A1—0 to 1 inch, black (10YR 2/1) sandy loam; weak, very fine, granular structure; very friable; many fine roots; strongly acid; abrupt, smooth boundary.

A2—1 to 4 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, fine, subangular blocky structure; very friable; many fine roots; strongly acid; abrupt, wavy boundary.

B1t—4 to 9 inches, dark yellowish-brown (10YR 4/4) sandy loam; weak, medium, subangular blocky structure; very friable; few fine roots; common thin clay bridges between mineral grains; about 3 percent gravel; medium acid; abrupt, wavy boundary.

B21t—9 to 13 inches, dark yellowish-brown (10YR 4/4) light sandy clay loam; weak, fine and medium, subangular blocky structure; very friable; few fine roots; continuous thin clay bridges between mineral grains; about 5 percent gravel; medium acid; clear, wavy boundary.

B22t—13 to 18 inches, dark yellowish-brown (10YR 3/4) light sandy clay loam; moderate, fine, subangular

blocky structure; friable; few fine roots; continuous, moderately thick clay bridges between mineral grains and common thin clay films on faces of peds; about 5 percent gravel; slightly acid; abrupt, wavy boundary.

R—18 to 60 inches, brownish-yellow (10YR 6/6) sandstone.

Thickness of the solum and depth to sandstone range from 10 to 20 inches. The A horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2) and is 1 to 3 inches thick. The A2 horizon ranges from dark grayish brown (10YR 4/2) to brown (10YR 5/3) and is 1 to 4 inches thick. The B horizon is dark brown (7.5YR 4/4 or 10YR 4/3) or dark yellowish brown (10YR 3/4–4/4). It is dominantly heavy sandy loam, light sandy clay loam, or loam. In some places, a thin IIB3 horizon of loamy sand or sandy loam occurs. The hardness of the bedrock is highly variable.

The Northfield soils in this survey area are more acid and have more sand in the solum than is defined as the range for the series.

Northfield soils occur with Boone and Military soils and are similar to Channahon soils. They are shallower over sandstone than Boone and Military soils and contain more clay in the B horizon than Boone soils. They are underlain by sandstone, whereas the Channahon soils are underlain by limestone.

Northfield sandy loam, 2 to 6 percent slopes (NoB).—This soil occurs as small, irregularly shaped areas just above sandstone ridges. It has a profile similar to the one described as representative of the series, but the surface layer is 1 to 2 inches thicker.

Included with this soil in mapping are small areas of Military fine sandy loam, 2 to 6 percent slopes. Also included are a few areas where the soil is eroded, a few nearly level areas, areas where the subsoil is dominantly sandy loam, and areas where the surface layer is loam or silt loam, and a few sandy spots, which are indicated by spot symbols on the soil map.

Runoff is slow. The erosion hazard is slight. Roots are limited by bedrock.

This soil is too shallow and droughty to be well suited to crops. Most of the acreage is in woodland or pasture. Capability unit IIIe–3; woodland group 3dl; wildlife group 3.

Northfield sandy loam, 6 to 12 percent slopes (NoC).—Small, irregularly shaped or long areas of this soil are along sandstone ridges or on the crests of rises on the till plain.

Included with this soil in mapping are small areas of Military fine sandy loam, 6 to 12 percent slopes, eroded. Also included are a few small areas where the subsoil is dominantly sandy loam or the surface layer is loam or silt loam, and a few spots of sand, which are indicated by spot symbols on the soil map.

Runoff is medium. The erosion hazard is moderate. Roots are limited by bedrock.

This soil is poorly suited to crops. Most of the acreage is forested. Capability unit IVe–3; woodland group 3dl; wildlife group 3.

Northfield sandy loam, 12 to 30 percent slopes (NoE).—This soil occurs as long and narrow areas, commonly 20 to 40 acres in size, along sandstone ridges. It has the profile described as representative of the Northfield series. It has many sandstone outcrops and a few escarpments, stony areas, and gullies, which are indicated by spot symbols on the soil map. It occurs among the Wyocena and Military soils and Rock land.

Included with this soil in mapping are small areas of Military fine sandy loam, 12 to 20 percent slopes, eroded, and areas of Rock land. Also included are many short slopes of more than 30 percent and a few places where the subsoil is dominantly sandy loam or the surface layer is loam or silt loam.

Runoff is rapid to very rapid. The erosion hazard is very severe. Roots are limited by bedrock. Shallowness over sandstone, the outcrops, the low available water capacity, and steep slopes restrict most uses of this soil.

Most of the acreage is forested. Capability unit VIIe–3; woodland group 3d2; wildlife group 3.

Okee Series

The Okee series consists of undulating to hilly, well-drained sandy soils. These soils formed in wind- or water-deposited sandy sediment and the underlying glacial till. They are on glacial moraines. The native vegetation was predominantly oak forest.

In a representative profile the surface layer is very dark grayish-brown loamy fine sand about 3 inches thick. The subsoil is about 31 inches thick. The upper 21 inches is dark yellowish-brown, very friable loamy fine sand; the next 6 inches is dark-brown, friable sandy clay loam; and the lower 4 inches is strong-brown, friable light sandy loam. The substratum is light yellowish-brown, calcareous glacial till of gravelly sandy loam texture.

These soils are droughty and subject to blowing. Permeability is rapid in the upper sandy sediment and moderate in the lower part of the subsoil. Available water capacity and fertility are medium.

These soils are cropped to corn, oats, and hay. Some areas have been planted to coniferous trees. Deep-rooted plants are better suited to these soils than shallow-rooted crops because most of the available water is in the lower part of the subsoil and in the substratum. The more sloping areas are used as permanent pasture or as woodland.

Representative profile of Okee loamy fine sand, 12 to 20 percent slopes, in a woodlot 21 feet west and 330 feet south of the northeast corner of NE¼NE¼ sec. 15, T. 10 N., R. 8 E.

A1—0 to 3 inches, very dark grayish-brown (10YR 3/2) loamy fine sand; weak, fine, crumb structure; very friable; many fine roots; common fine and few medium tubular pores; neutral; abrupt, irregular boundary.

B1—3 to 24 inches, dark yellowish-brown (10YR 4/4) loamy fine sand; very weak, coarse, subangular blocky structure; very friable; common fine roots; few medium tubular pores; about 2 percent gravel; slightly acid; clear, wavy boundary.

IIB2t—24 to 30 inches, dark-brown (7.5YR 4/4) sandy clay loam; moderate, coarse, subangular blocky structure parting to moderate, fine, subangular and angular blocky; friable, slightly sticky, slightly plastic; many thin clay films; common fine roots; common fine and few medium tubular pores; approximately 5 percent gravel and 5 percent cobblestones; medium acid; clear, wavy boundary.

IIB3t—30 to 34 inches, strong-brown (7.5YR 5/6) light sandy loam; weak, coarse, subangular blocky structure; friable; common, thin, dark-brown (7.5YR 4/4) clay films; few fine roots; many fine tubular pores; approximately 5 percent gravel and 5 per-

cent cobblestones; medium acid; clear, wavy boundary.

IIC—34 to 60 inches, light yellowish-brown (10YR 6/4) gravelly sandy loam; massive; very friable; approximately 30 percent gravel and 10 percent cobblestones; strong effervescence with dilute HCl.

The solum is typically 30 to 50 inches thick but ranges to 60 inches. It is medium acid to neutral in the upper sandy sediment and medium acid to mildly alkaline in the Bt horizon. The sand sediment is 20 to 40 inches thick. The A1 horizon is very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2) and is 1 to 4 inches thick. In some areas there is an Ap horizon, which is dark yellowish brown (10YR 4/4) or brown (10YR 4/3) and 6 to 11 inches thick. The B1 horizon is light yellowish-brown (10YR 6/4) or dark yellowish-brown (10YR 4/4) loamy sand, or loamy fine sand 16 to 39 inches thick. The IIBt horizon is dark brown (7.5YR 4/4), strong brown (7.5YR 5/6 to 5/8), or reddish brown (5YR 4/4) and is 10 to 20 inches thick. The IIC horizon is sandy loam or loamy sand and is commonly gravelly.

Okee soils are near Plainfield and Wyocena soils. They formed in 20 to 40 inches of sandy sediment and the underlying glacial till, unlike the Plainfield soils, which formed in deep sandy deposits. They are more sandy in the upper part of the B horizon than Wyocena soils.

Okee loamy fine sand, 2 to 6 percent slopes (OkB).—This soil is in irregularly shaped areas on undulating ground moraines. Most areas are 30 to 60 acres in size. This soil has a profile similar to the one described as representative of the series, but the sandy surface layer and upper part of the subsoil are 5 to 10 inches thicker, and the thickness of the surface layer and subsoil combined commonly is 40 to 50 inches.

Included with this soil in mapping are some small areas where the sandy surface sediment is less than 20 inches thick. Also included are small areas where the surface layer is fine sandy loam.

This soil is droughty in the sandy upper part and is not well suited to shallow-rooted crops. Runoff is slow. Seedling mortality can be a serious problem.

This soil is well suited to some species of coniferous trees, and some acreage is used to grow Christmas trees. Most of the acreage is cropped to corn, oats, or hay. Some is used for forage or woodland. Capability unit IIIs–4; woodland group 2s1; wildlife group 3.

Okee loamy fine sand, 6 to 12 percent slopes (OkC).—This soil is in irregularly shaped areas on rolling glacial uplands and in long and somewhat narrow areas on the sides of glacial drumlins. Most areas are less than 40 acres in size. This soil has the profile described as representative of the series. Most areas have been plowed.

Included with this soil in mapping are small areas of Wyocena loamy sand, 6 to 12 percent slopes, eroded, and small areas of Plainfield loamy fine sand, loamy substratum, 6 to 12 percent slopes. Also included are some small areas of blowouts, which are indicated by spot symbols on the soil map; and small areas on the crests of hills where less than 20 inches of sandy sediment is on the surface.

This soil is droughty in the sandy upper part and is not well suited to shallow-rooted crops. Runoff is slow.

This soil is suited to deep-rooted crops. Most is now in hay or permanent pasture. Some acreage is cropped to corn and oats, and some is planted to coniferous trees. Capability unit IIIe–7; woodland group 2s1; wildlife group 3.

Oshtemo Series

The Oshtemo series consists of well-drained sandy soils underlain at a depth of 40 to 66 inches by calcareous sand or stratified sand and gravel outwash. These soils are on outwash plains, valley trains, and moraines. Some small depressions are indicated by spot symbols on the soil map. Slopes range from 0 to 20 percent. The native vegetation was deciduous trees.

In a representative profile the surface layer is very dark grayish-brown loamy sand about 7 inches thick. The subsoil is about 39 inches thick. The upper 31 inches is dark-brown, very friable light sandy loam, and the lower 8 inches is dark-brown, very friable loamy sand. The substratum is very pale brown, moderately alkaline sand that contains some gravel.

These soils tend to be droughty and are susceptible to blowing. Permeability is moderately rapid. Available water capacity and fertility are low.

These soils are a source of sand and gravel. Most of the acreage is cultivated.

Representative profile of Oshtemo loamy sand, 2 to 6 percent slopes, in a cornfield 60 feet south and 190 feet east of the northwest corner of NE¼NE¼ sec. 20, T. 12 N., R. 10 E.

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) loamy sand; weak, coarse, subangular blocky structure; very friable; common fine roots; neutral; abrupt, smooth boundary.

B21t—7 to 17 inches, dark-brown (7.5YR 4/4) light sandy loam: weak, medium, subangular blocky structure; very friable; common fine roots; about 2 percent gravel; common thin clay bridges between mineral grains; slightly acid; clear, wavy boundary.

B22t—17 to 38 inches, dark-brown (7.5YR 4/4) light sandy loam; weak, coarse, subangular blocky structure; very friable; common fine roots; about 5 percent gravel; common thin clay bridges between mineral grain; medium acid; clear, wavy boundary.

B3—38 to 46 inches, dark-brown (7.5YR 3/4) loamy sand; weak, coarse, subangular blocky structure; very friable; few fine roots; about 10 percent gravel; very few thin clay bridges between mineral grains; slightly acid; abrupt, wavy boundary.

IIC—46 to 60 inches, very pale brown (10YR 7/3) sand; about 15 percent gravel; single grained; loose; moderately alkaline; slight effervescence.

The solum ranges from 40 to 66 inches in thickness and is as much as 25 percent gravel. The Ap horizon ranges from very dark grayish brown (10YR 3/2) to brown (10YR 4/3), and the content of organic matter is estimated to be very low. If it occurs, the A1 horizon is very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2), is less than 5 inches thick, and is loamy sand or fine sandy loam. In some places there is an A2 horizon of brown (10YR 4/3 or 5/3) or yellowish-brown (10YR 5/4) loamy sand or fine sandy loam that is less than 6 inches thick. The B2t horizon is commonly light sandy loam, sandy loam, or heavy sandy loam, but in some places as much as 6 inches is sandy clay loam. The B3 horizon ranges from dark brown (7.5YR 3/4) to strong brown (7.5YR 5/6) or is dark yellowish brown (10YR 3/4). In some places, the lower part of the B horizon is in layers of sandy loam, 1 to 4 inches thick, that are separated by loamy sand. The B horizon is commonly slightly acid or medium acid in reaction but ranges to mildly alkaline in the lower part. The IIC horizon is stratified sand and gravel, or it is mostly sand and some gravel.

The Oshtemo soils in this survey area lack the 5YR color that is defined as the range for the series.

Oshtemo soils occur with Boyer, Dresden, and Wasepi soils. Their solum is thicker than that of the Boyer and Dresden soils, and it contains less clay than that of the Dresden soils. They are not so wet as Wasepi soils.

Oshtemo loamy sand, 0 to 2 percent slopes (OmA).—Large, irregularly shaped areas of this soil are on valley floors and on broad outwash plains near Boyer soils. The few gravel pits are indicated by symbols on the soil map. This soil has a profile similar to the one described as representative of the series, but the surface layer is about 9 inches thick and in some places it has a thin subsurface layer of brown loamy sand.

Included with this soil in mapping are small areas of Boyer loamy sand, 0 to 2 percent slopes; Oshtemo loamy sand, 2 to 6 percent slopes; and Plainfield loamy fine sand, 0 to 2 percent slopes. Also included are some areas where the surface layer is thicker and darker colored and areas where the lower part of the subsoil is saturated during wet seasons.

Runoff is very slow. The hazard of water erosion is slight.

This soil has excellent potential for growing special crops under irrigation and is a source of sand and gravel. Most of the acreage is cultivated or pastured. Some is wooded. Capability unit IIIs–4; woodland group 3o1; wildlife group 3.

Oshtemo loamy sand, 2 to 6 percent slopes (OmB).—Large, broad, irregularly shaped areas of this soil are on undulating outwash plains near Boyer soils. Some areas are hundreds of acres in size. The few gravel pits are indicated by symbols on the soil map. This soil has the profile described as representative of the series. Small areas are saturated at a depth of about 30 to 50 inches during wet seasons.

Included with this soil in mapping are small areas of Boyer loamy sand, 2 to 6 percent slopes; Oshtemo loamy sand, 0 to 2 percent slopes; and Plainfield loamy fine sand, 2 to 6 percent slopes. Also included are some small areas where the surface layer is darker colored and areas where part of the surface layer has been lost through soil blowing.

Runoff is slow. The hazard of water erosion is slight.

This soil has good potential for growing special crops under irrigation and is a source of sand and gravel. Most of the acreage is cropped or pastured. Growth of crops is limited by low available water capacity and low fertility. Capability unit IIIs–4; woodland group 3o1; wildlife group 3.

Oshtemo loamy sand, 6 to 12 percent slopes, eroded (OmC2).—Large, irregularly shaped or long areas of this soil are on rises on outwash plains, on moraines, or along valley sides. The surface layer is commonly dark grayish brown, very dark grayish brown, or dark brown and about 5 to 7 inches thick. In some wooded spots, the surface layer is very dark brown and less than 5 inches thick, and there is a subsurface layer of brown loamy sand about 4 inches thick. In the more eroded spots, material from the subsoil is exposed at the surface.

Included with this soil in mapping are small areas of Boyer loamy sand, 6 to 12 percent slopes, eroded; Plainfield loamy fine sand, 6 to 12 percent slopes; and Wyocena loamy sand, 6 to 12 percent slopes, eroded.

Runoff is medium. The hazard of water erosion is moderate. Low available water capacity and low fertility are the major limitations.

This soil is a source of sand and gravel. Most of the acreage is in hay or pasture. Capability unit IIIe–7; woodland group 3o1; wildlife group 3.

Oshtemo loamy sand, 12 to 20 percent slopes, eroded (OmD2).—Narrow, long areas of this soil are along short valley sides. The areas are commonly less than 15 acres in size. The surface layer is commonly very dark grayish brown or dark grayish brown and about 1 to 3 inches thick, and the subsurface layer is brown loamy sand about 4 to 6 inches thick.

Included with this soil in mapping are small areas of Boyer loamy sand, 12 to 30 percent slopes, eroded; Plainfield loamy fine sand, 12 to 25 percent slopes; and Wyocena loamy sand, 12 to 20 percent slopes, eroded. In a few places, glacial till or sandstone is at a depth of 40 to 60 inches.

Runoff is rapid. The hazard of water erosion is severe.

This soil is limited by low available water capacity and low fertility and is poorly suited to cultivated crops. Most of the acreage is in pasture or woodland. Capability unit IVe–7; woodland group 3r2; wildlife group 3.

Ossian Series

The Ossian series consists of poorly drained silty soils. These soils formed in deposits of silty sediment that is underlain at a depth of more than 50 inches by loamy glacial till, sand and gravel glacial outwash, or lacustrine silt and sand. They are in broad depressions, on valley floors along drainageways, and in low concave areas within areas of silty soils. Slopes range from 0 to 3 percent. The native vegetation was water-tolerant grasses.

In a representative profile the surface layer is about 15 inches thick. It is black silt loam in the upper part and black silty clay loam in the lower part. Just below the surface layer is a transitional layer of mixed black and very dark gray light silty clay loam about 3 inches thick. The subsoil is about 15 inches thick. The upper 12 inches is olive-gray, friable light silty clay loam, and the lower 3 inches is gray, friable silt loam. The substratum is gray, mildly alkaline silt loam.

These soils are saturated at or near the surface throughout most of the year. They are subject to ponding in spring and after a heavy rain (fig. 16). Permeability is moderate to moderately slow. Available water capacity and fertility are high.

Most of the acreage is cropped or pastured.

Representative profile of Ossian silt loam, 0 to 3 percent slopes, in a field of clover 522 feet north and 480 feet east of the southwest corner of SE¼SW¼ sec. 24, T. 10 N., R. 12 E.

Ap—0 to 8 inches, black (10YR 2/1) silt loam; weak, fine, subangular blocky structure; friable; common fine roots; moderately alkaline; abrupt, smooth boundary.

A12—8 to 15 inches, black (10YR 2/1) light silty clay loam; weak, medium, subangular blocky structure; friable; few fine roots; few fine tubular pores; moderately alkaline; clear, wavy boundary.

AB—15 to 18 inches, mixed black (10YR 2/1) and very dark gray (10YR 3/1) light silty clay loam; many, fine, prominent, olive-gray (5Y 5/2) mottles; moderate, very fine, subangular blocky structure; friable;

Figure 16.—Water ponded on an Ossian soil.

few fine roots; few fine and medium tubular pores; few thin clay films in pores; mildly alkaline; clear, wavy boundary.

B21g—18 to 21 inches, olive-gray (5Y 5/2) light silty clay loam; few, fine, faint and prominent, dark-gray (5Y 4/1) and strong-brown (7.5YR 5/8) mottles; moderate, fine, subangular blocky structure; friable; few fine roots; few fine and coarse tubular pores; few thin films in pores; mildly alkaline; clear, wavy boundary.

B22g—21 to 25 inches, olive-gray (5Y 5/2) light silty clay loam; common, fine, prominent, strong-brown (7.5YR 5/6) and yellowish-red (5YR 4/8) mottles; weak, medium, prismatic structure parting to weak, medium, subangular blocky; friable; few fine roots; few coarse tubular pores; few thin clay films in pores; mildly alkaline; clear, wavy boundary.

B23g—25 to 30 inches, olive-gray (5Y 5/2) light silty clay loam; many, prominent, strong-brown (7.5YR 5/6) and yellowish-red (5YR 4/8) mottles; weak, medium, prismatic structure parting to weak, coarse, subangular blocky; friable; few fine roots; few medium tubular pores; few thin clay films in pores; mildly alkaline; clear, wavy boundary.

B3g—30 to 33 inches, gray (5Y 5/1) silt loam; few, fine and medium, prominent, strong-brown (7.5YR 5/6) and dark reddish-brown (5YR 3/4) mottles; weak, coarse, prismatic structure; friable; few fine roots; few coarse tubular pores; very few thin clay films in pores; mildly alkaline; clear, wavy boundary.

Cg—33 to 60 inches, gray (5Y 5/1) silt loam; few, fine, prominent, dark yellowish-brown (10YR 4/4) mottles along pores; massive; friable; few fine roots; few medium tubular pores; mildly alkaline; slight effervescence.

The solum typically ranges from 30 to 40 inches in thickness, but in places ranges to 50 inches. Below the influence of agricultural lime it is typically neutral or mildly alkaline, but in some places it is slightly acid or moderately alkaline. It commonly formed in more than 50 inches of silty material underlain by outwash or till. Depth to carbonates is more than 40 inches. The A horizon ranges from 10 to 24 inches in thickness. The A and B horizons are silt loam, heavy silt loam, or light silty clay loam. The C horizon is typically silt loam, but in some places it is loamy glacial till, sand, and gravel glacial outwash, or stratified lacustine silt and fine sand.

In many areas the Ossian soils in this survey area are more alkaline than is defined as the range for the series.

Ossian soils form a drainage sequence with the well drained and moderately well drained St. Charles soils and the somewhat poorly drained Atterberry soils. They also occur with Wacousta soils, which occupy slight depressions within areas of Ossian soils, but in contrast they are not mucky and they have a thicker solum. They have a thicker A horizon and are wetter than Atterberry and St. Charles soils.

Ossian silt loam, 0 to 3 percent slopes (OsA).—Larger areas of this soil are in broad depressions. Smaller areas are on valley floors along drainageways.

Included with this soil in mapping are small areas of Wacousta mucky silt loam and Otter silt loam and some small areas where glacial till is at a depth of 30 to 50 inches. Also included are a few small spots of Marsh, which are indicated by spot symbols on the soil map.

Runoff is very slow to ponded. There is little or no erosion hazard. Wetness, along with occasional overflow from runoff, is the major limitation.

Undrained areas of this soil are used as pasture. Drained areas are cropped to corn or other vegetables. Capability unit IIw–1; woodland group 3w5; wildlife group 5b.

Otter Series

The Otter series consists of nearly level poorly drained silty soils. These soils formed in recent silty alluvium washed mainly from soils formed in loess on adjoining uplands and deposited over a mineral soil. They are on valley floors along streams and in low areas that receive runoff from adjacent uplands. Uncultivated areas are in water-tolerant grasses and sedges.

In a representative profile the surface layer is black silt loam and silty clay loam about 28 inches thick. The substratum is just below the surface layer. The upper 6 inches is gray, mildly alkaline silt loam. This is underlain by dark-gray, moderately alkaline silty clay loam.

These soils are saturated at or near the surface throughout most of the year. They are subject to ponding in spring and after heavy rains and to frequent flooding or overflow from runoff from adjacent uplands. Permeability is moderate. Available water capacity is very high. Fertility is high.

If drained, these soils are used for corn and vegetable crops. Most of the acreage is in pasture.

Representative profile of Otter silt loam (0 to 2 percent slopes), in a field of clover 441 feet north and 354 feet east of the southwest corner of NE¼SW¼ sec. 18, T. 12 N., R. 8 E.

Ap—0 to 7 inches, black (10YR 2/1) silt loam; moderate, fine and medium, subangular blocky structure; very friable; common fine roots; mildly alkaline; abrupt, smooth boundary.

A12—7 to 21 inches, black (10YR 2/1) silt loam; few, fine, prominent, strong-brown (7.5YR 5/6) mottles; weak, fine and medium, subangular blocky structure; very friable; common fine roots; mildly alkaline; abrupt, smooth boundary.

A13—21 to 28 inches, black (10YR 2/1) silty clay loam; few, fine, prominent, strong-brown (7.5YR 5/6) mottles and few, medium, prominent, grayish-brown (10YR 5/2) mottles; moderate, very fine, subangular blocky structure; friable; few fine roots; mildly alkaline; clear, wavy boundary.

C1g—28 to 34 inches, gray (5Y 5/1) silt loam; common, fine, prominent, strong-brown (7.5YR 5/6) mottles; weak, fine and medium, subangular blocky structure; friable; few fine roots; mildly alkaline; clear, wavy boundary.

C2g—34 to 60 inches, dark-gray (5Y 4/1) silty clay loam; common, fine, prominent, yellowish-red (5YR 4/8) mottles; massive; friable; moderately alkaline; slight effervescence.

The A horizon ranges from 24 to 40 inches in thickness. It is black (10YR 2/1), very dark brown (10YR 2/2), or very dark gray (10YR 3/1) silt loam or silty clay loam, but in some places it has thin strata of loam or sandy loam. Reaction ranges from slightly acid to mildly alkaline. The C horizon is mostly silt loam or silty clay loam, but in some places it is stratified silt loam, loam, sandy loam, or silty clay loam. The C horizon ranges from neutral to moderately alkaline.

Otter soils are similar to Wallkill and Troxel soils. In contrast, they are underlain by mineral sediment, whereas Wallkill soils are underlain by organic deposits. They are poorly drained, whereas Troxel soils are well drained and moderately well drained.

Otter silt loam (0 to 2 percent slopes) (Ot).—This soil is in broad and long or fan-shaped areas on valley floors along streams and in low areas that receive runoff from adjoining uplands. Some large areas, ranging up to several hundred acres in size, are along major streams. Some long and narrow areas are on old bayous of meandering streams.

Included with this soil in mapping are some small areas that are slightly better drained; a few areas where an old, buried surface layer is at a depth of 30 to 60 inches; a few small spots of Marsh, which are indicated by spot symbols on the soil map; small areas where the alluvium is loamy rather than silty; and a few areas where thin strata of muck are within the silty sediment. Also included are a few small areas of Alluvial land, loamy, wet.

Runoff is very slow to ponded. There is little or no erosion hazard. Wetness, along with frequent flooding or overflow, is the major limitation.

Most of the acreage is pastured. A few drained areas are used for crops. Capability unit IIw–1; woodland group 1w5; wildlife group 5b.

Palms Series

The Palms series consists of nearly level, very poorly drained organic soils underlain by loamy mineral soil. The organic material is 16 to 50 inches of well-decomposed residue from water-tolerant plants. These soils are in broad glacial lakebeds, in depressions, and along drainageways. The native vegetation was mainly reeds and sedges.

In a representative profile the surface layer is dark reddish-brown muck about 13 inches thick. It is underlain by about 17 inches of dark-brown and black, medium acid muck. The lower 5 inches of this layer is about 60 percent mineral soil material. The substratum is dark-gray and greenish-gray silty clay loam.

Unless drained, these soils are saturated at or near the surface throughout most of the year. Permeability is moderately rapid in the organic material and moderately slow in the mineral substratum. Available water capacity is very high. Fertility is low.

In drained areas, Palms soils are cropped intensively to corn, truck crops, and mint. Some acreage is used for growing sod for lawns. Undrained areas are suited to permanent pasture or wildlife habitat.

Representative profile of Palms muck (0 to 2 percent slope), 380 feet east and 370 feet south of the northwest corner of SE¼NW¼ sec. 23, T. 13 N., R. 8 E.

Oap—0 to 13 inches, dark reddish-brown (5YR 2/2) sapric material, very dark brown (10YR 2/2) rubbed and pressed; about 70 percent fiber, 5 percent rubbed; weak, coarse, subangular blocky structure; very

friable; primarily herbaceous fibers; slightly acid (pH 6.2 in H_2O); abrupt, wavy boundary.

Oa2—13 to 20 inches, dark-brown (7.5YR 4/4) sapric material, dark reddish brown (5YR 2/2) rubbed and pressed; about 90 percent fiber, 9 percent rubbed; weak, platy structure; friable; primarily herbaceous fibers; medium acid (pH 6.0 in H_2O); clear, wavy boundary.

Oa3—20 to 25 inches, black (5YR 2/1) sapric material, black (10YR 2/1) rubbed and pressed; about 15 percent fiber, 1 percent rubbed; weak, platy structure; friable; primarily herbaceous fibers; medium acid (pH 5.8 in H_2O); clear, wavy boundary.

Oa4—25 to 30 inches, black (10YR 2/1) sapric material; about 10 percent fiber, 1 percent rubbed; massive; friable; primarily herbaceous fibers; approximately 60 percent mineral material; medium acid (pH 6.0 in H_2O); gradual, wavy boundary.

IIC1g—30 to 35 inches, dark-gray (N 4/0) silty clay loam; massive; friable; sticky, plastic; common fine tubular pores; few light-red (2.5YR 6/6), partly decomposed reed fibers; slightly acid; abrupt, wavy boundary.

IIC2g—35 to 60 inches, greenish-gray (5BG 5/1) silty clay loam; massive; friable; sticky, plastic; few thin bands of sand; mildly alkaline.

The organic soil ranges from 16 to 50 inches in thickness. It is primarily herbaceous, but in some places contains woody fragments. The layers are black, very dark brown, dark brown, or dark reddish brown. They are generally muck, but thin layers of peat are in some places. The C horizon is typically silt loam, silty clay loam, or loam, but in some places it is sandy loam.

Palms soils are near Adrian and Houghton soils. They formed in shallower deposits of organic material than Houghton soils. They have a loamy C horizon, whereas Adrian soils have a sandy C horizon.

Palms muck (0 to 2 percent slopes) (Pa).—This soil occurs as large areas in depressions and on valley floors of streams. Smaller areas are also in depressions and in pockets along drainageways. Some areas bordering Houghton soils in the large depressions are long and narrow.

Included with this soil in mapping are small areas where the substratum is stratified with silt and sand and small areas along drainageways where the organic material contains thin strata of mineral soil. Also included are small areas of Adrian muck and Houghton muck; small areas, generally adjacent to lakes, where the muck is underlain by marl; and spots of Marsh, which are indicated by spot symbols on the soil map.

Palms muck is subject to ponding in spring and after heavy rains. Runoff is very slow. Along streams the soil is subject to occasional flooding. If it is drained and cultivated, soil blowing and subsidence are hazards.

Most of the larger areas are cultivated. Corn, truck crops, and mint are the major crops. Some areas are used for growing sod for lawns. Drained areas can be intensively cropped if fertility is maintained and soil blowing and subsidence are controlled. Undrained areas are used as pasture or wildlife habitat. Capability unit IIw–8; woodland group not classified; wildlife group 6.

Plainfield Series

The Plainfield series consists of excessively drained sandy soils that formed in sandy deposits generally 40 inches or more in thickness. In some places, loamy or silty material occurs at a depth of 40 to 60 inches. These soils are on outwash plains, stream terraces, and moraines. Blowouts are common, as indicated by spot symbols on the soil map, and in some places, the sand is actively shifting. Slopes are commonly 0 to 12 percent, but range to 25 percent. The native vegetation was oak forest.

In a representative profile the surface layer is very dark grayish-brown loamy fine sand about 3 inches thick. The subsoil is about 29 inches thick. The upper 11 inches is dark yellowish-brown loamy fine sand, and the lower 18 inches is yellowish-brown fine and medium sand. The substratum is brownish-yellow, neutral fine and medium sand.

These soils are droughty and susceptible to blowing. Permeability is rapid. Available water capacity and fertility are low to very low. The weatherable mineral content is low.

If irrigated, these soils are suited to special crops. Most of the acreage is forested or used as pasture. Pine plantations are established in many areas.

Representative profile of Plainfield loamy fine sand, 6 to 12 percent slopes, 528 feet north and 30 feet east of the southwest corner of sec. 36, T. 13 N., R. 8 E.

A1—0 to 3 inches, very grayish-brown (10YR 3/2) loamy fine sand; weak, very fine, granular structure; very friable; many fine roots; neutral; abrupt, smooth boundary.

B2—3 to 14 inches, dark yellowish-brown (10YR 4/4) loamy fine sand; weak, medium, subangular blocky structure; very friable; common fine roots; slightly acid; clear, wavy boundary.

B3—14 to 32 inches, yellowish-brown (10YR 5/6) medium and fine sand; single grained; loose; few fine roots; slightly acid; gradual, wavy boundary.

C—32 to 60 inches, brownish-yellow (10YR 6/6) medium and fine sand; single grained; loose; neutral.

The solum ranges from 18 to 34 inches in thickness. It is typically slightly acid, but ranges from medium acid to neutral. The A1 horizon is very dark brown (10YR 2/2), dark brown (10YR 3/3), or very dark grayish brown (10YR 3/2) and ranges from 1 to 4 inches in thickness. In cultivated areas the Ap horizon is very dark grayish brown (10YR 3/2), brown (10YR 4/3), or dark grayish brown (10YR 4/2). The B horizon ranges from dark yellowish brown (10YR 4/4) to brownish yellow (10YR 6/6) and is loamy sand, loamy fine sand, fine sand, or medium sand. Between depths of 10 and 40 inches, the soil is more than 50 percent medium and coarser sand. The C horizon is commonly slightly acid or neutral.

The Plainfield soils in this survey area are less acid than is defined as the range for the series.

Plainfield soils occur with Boone, Chelsea, Morocco, Okee, and Sparta soils. They contain more weatherable minerals than Boone soils and do not have sandstone at a depth of 20 to 40 inches. In contrast with Chelsea soils, they do not have bands of loamy material at a depth of 40 to 60 inches. They are not so wet as the somewhat poorly drained Morocco soils. Unlike the Okee soils, which formed in 20 to 40 inches of sandy deposits and underlying loamy glacial till, the Plainfield soils formed in deep sandy deposits. Their A horizon is thinner and contains less organic matter than that of the Sparta soils.

Plainfield sand, 2 to 12 percent slopes, eroded (PeC2).—This soil is in small, irregularly shaped areas on outwash plains. Blowouts occupy a large part of the acreage. They consist of sand-sized particles, drifted and piled up by the wind, that are either actively shifting or have been recently stabilized. The sandy sediment is 60 inches or more deep.

Included with this soil in mapping are small areas of Plainfield loamy fine sand, 2 to 6 percent slopes, and Plainfield loamy fine sand, 6 to 12 percent slopes. Also

included are small areas where loamy material is at a depth of 40 to 60 inches.

Available water capacity is very low. Runoff is slow.

This soil is difficult to vegetate and stabilize. The plant cover, if any, is a sparse growth of oak trees and grasses. Coniferous trees have been planted on much of the acreage. This soil is a source of sand. It is better suited to some species of conifers than to other plants. Capability unit VIIs–9; woodland group 3s1; wildlife group 3.

Plainfield loamy fine sand, 0 to 2 percent slopes (PfA). —Large, irregularly shaped areas of this soil are on stream terraces and in slight depressions on the outwash plain. The profile is similar to the one described as representative of the series, but the surface layer is commonly very dark brown and is slightly thicker. In tilled areas, part of the subsoil has been mixed with the original surface layer. This plow layer is dark grayish brown or dark brown and is 8 or 9 inches thick. On some terraces, which are indicated by spot symbols on the soil map, this soil is mottled at a depth of about 30 to 60 inches.

Included with this soil in mapping are small areas of Plainfield loamy fine sand, loamy substratum, 2 to 6 percent slopes, and Sparta loamy fine sand, 1 to 6 percent slopes. Also included are a few wet spots; small depressions, which are indicated by spot symbols on the soil map; and a few areas where the surface layer is loamy sand.

Runoff is very slow. The hazard of water erosion is slight.

This soil is well suited to special crops under irrigation and to some species of conifers (fig. 17). Most of the acreage is forested or pastured. Some is cropped to corn, hay, or small grain. Some is in Christmas trees. Capability unit IVs–3; woodland group 3s1; wildlife group 3.

Plainfield loamy fine sand, 2 to 6 percent slopes (PfB). —Large, irregularly shaped areas of this soil are on stream terraces and on slight rises on outwash plains. The profile is similar to the one described as representative of the series, but in cultivated areas the surface layer is commonly dark grayish brown or dark brown and is about 9 inches thick. In some places, commonly on terraces, this soil is mottled at a depth of about 30 to 60 inches. These places are indicated by spot symbols on the soil map.

Included with this soil in mapping are a few small areas of Plainfield loamy fine sand, 0 to 2 percent slopes, and Plainfield loamy fine sand, loamy substra-

Figure 17.—Red pine plantation on Plainfield soil.

tum, 2 to 6 percent slopes. Also included are a few areas where part of the surface layer has been lost through soil blowing and areas where sandstone is at a depth of 40 to 60 inches.

This soil is more susceptible to blowing than the less sloping Plainfield soils. Runoff is slow. The hazard of water erosion is slight. Seedling mortality can be serious.

This soil is well suited to irrigation. Most of the acreage is used as pasture or woodland. Many small areas are planted to conifers, which are harvested as Christmas trees in some places. Capability unit IVs–3; woodland group 3s1; wildlife group 3.

Plainfield loamy fine sand, 6 to 12 percent slopes (PfC).—This soil is in irregularly shaped or long, narrow areas on valley sides and on rises on the outwash plain. Some areas range up to several hundred acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Plainfield loamy fine sand, loamy substratum, 6 to 12 percent slopes. Also included are a few small areas where the surface layer is loamy sand or is thicker and darker colored and areas where sandstone is at a depth of 40 to 60 inches.

Runoff is medium. The hazard of water erosion is slight. Low fertility and droughtiness are the major limitations.

This soil is poorly suited to crops. Most of the acreage is forested. Many areas, formerly used as pasture, are now pine tree plantations. Capability unit VIs–3; woodland group 3s1; wildlife group 3.

Plainfield loamy fine sand, 12 to 25 percent slopes (PfD).—This soil is commonly in long areas on the sides on valleys and ridges. The areas are commonly 20 to 60 acres in size. Slopes are typically 12 to 20 percent.

Included with this soil in mapping are a few small areas of Plainfield loamy fine sand, loamy substratum, 12 to 25 percent slopes, and Boone loamy fine sand, 12 to 45 percent slopes. Also included are a few small areas where the surface layer is loamy sand.

Runoff is medium. The hazard of water erosion is moderate.

Most of the acreage is in scrub oak trees and grasses. A few small areas are in pasture. Capability unit VIIs–3; woodland group 3s2; wildlife group 3.

Plainfield loamy fine sand, loamy substratum, 2 to 6 percent slopes (PkB).— Large, irregularly shaped areas of this soil are on stream terraces and on slight rises on the till and outwash plains. The profile is similar to the one described as representative of the series, but loamy glacial till, silty sediment, or loamy lacustrine deposits are at a depth of about 40 to 60 inches. Mottles commonly occur just above the loamy material.

Included with this soil in mapping are small areas of Plainfield loamy fine sand, 2 to 6 percent slopes; Okee loamy fine sand, 2 to 6 percent slopes; and Puchyan loamy fine sand, 2 to 6 percent slopes. Also included are a few areas where the surface layer is thicker and darker colored and a few nearly level areas.

During wet seasons, this soil is commonly saturated above the loamy or silty material. Runoff is slow. The hazard of water erosion is slight. Permeability is moderate in the underlying loamy or silty material.

This soil is better suited to deep-rooted plants than to shallow-rooted plants because the underlying loamy material contains most of the available water and nutrients. Most of the acreage is used as pasture or woodland. Trees grow larger on this soil than on Plainfield loamy fine sand, 2 to 6 percent slopes. Capability unit IVs–3; woodland group 3s1; wildlife group 3.

Plainfield loamy fine sand, loamy substratum, 6 to 12 percent slopes (PkC).—This soil is in irregularly shaped or long, narrow areas on valley sides and on rises on the till and outwash plains. The areas are commonly 20 to 40 acres in size. This soil has a profile similar to the one described as representative of the series, but it has loamy glacial till, silty sediment, or loamy lacustrine deposits at a depth of about 40 to 60 inches. Mottles commonly occur just above the loamy material.

Included with this soil in mapping are small areas of Chelsea loamy fine sand, 6 to 12 percent slopes; Plainfield loamy fine sand, 6 to 12 percent slopes; Okee loamy fine sand, 6 to 12 percent slopes; and Puchyan loamy fine sand, 6 to 12 percent slopes. Also included are a few places where the surface layer is loamy sand and areas where part of it has been lost through soil blowing.

During wet seasons, this soil is commonly saturated just above the loamy or silty material. Runoff is medium. The hazard of water erosion is slight. Permeability is moderate in the underlying loamy or silty material.

This soil is better suited to deep-rooted plants than to shallow-rooted plants because the underlying loamy material contains most of the available water and nutrients. Most of the acreage is used as pasture or forested. Trees grow larger on this soil than on Plainfield loamy fine sand, 6 to 12 percent slopes. Capability unit VIs–3; woodland group 3s1; wildlife group 3.

Plainfield loamy fine sand, loamy substratum, 12 to 25 percent slopes (PkD).—Long, narrow areas of this soil are on valley sides and along ridges. Slopes are typically 12 to 20 percent. This soil has a profile similar to the one described as representative of the series, but it has loamy or silty material at a depth of 40 to 60 inches.

Included with this soil in mapping are small areas of Plainfield loamy fine sand, 12 to 25 percent slopes. Also included are a few small areas where the loamy material contains bands of sandy material and areas where most of the surface layer has been lost through soil blowing.

Runoff is medium. The hazard of water erosion is moderate. Permeability is moderate in the loamy material.

This soil is well suited to deep-rooted plants because most of the available water and nutrients are in the underlying loamy material. Most of the acreage is forested. Trees grow larger on this soil than on Plainfield loamy fine sand, 12 to 25 percent slopes. Capability unit VIIs–3; woodland group 3s2; wildlife group 3.

Plano Series

The Plano series consists of well drained and moderately well drained silty soils. These soils formed in

40 to 60 inches of silty sediment and the underlying sandy loam till. They are on silt covered till plains. Slopes are typically 0 to 8 percent but range up to 12 percent. In moderately well drained areas slopes are typically 0 to 4 percent. The native vegetation was mixed grasses.

In a representative profile the surface layer is silt loam about 13 inches thick. The upper 9 inches is black, and the lower 4 inches is very dark brown. The subsoil extends to a depth of more than 60 inches. The upper 13 inches is dark yellowish-brown, friable silt loam and heavy silt loam; the next 19 inches is dark yellowish-brown light silty clay loam; the next 6 inches is dark yellowish-brown, friable loam; and the lower 9 inches is dark-brown, friable heavy sandy loam.

In some places, these soils are saturated at a depth of about 3 to 5 feet for significant periods during wet seasons. Permeability is moderate. Available water capacity and fertility are high.

These soils are well suited to crops and are cropped intensively. Corn is the major crop. Some areas are in peas or small grain.

Representative profile of Plano silt loam, 2 to 6 percent slopes, 147 feet west and 174 feet north of the southeast corner of NE¼NW¼ sec. 35, T. 13 N., R. 11 E.

Ap—0 to 9 inches, black (10YR 2/1) silt loam; moderate, fine, subangular blocky structure; friable; common fine roots; few fine and medium tubular pores; neutral; abrupt, smooth boundary.

A12—9 to 13 inches, very dark brown (10YR 2/2) silt loam; moderate, medium, subangular blocky structure; friable; common fine roots; common fine and few medium tubular pores; slightly acid; clear, wavy boundary.

B1—13 to 17 inches, dark yellowish-brown (10YR 3/4) silt loam; weak, medium, subangular blocky structure; very friable; common fine roots; many fine and few medium tubular pores; medium acid; clear, wavy boundary.

B21t—17 to 26 inches, dark yellowish-brown (10YR 4/4) heavy silt loam; weak, fine and medium, subangular blocky structure; friable; few fine roots; many fine and few medium tubular pores; common thin clay films on faces of peds; medium acid; clear, wavy boundary.

B22t—26 to 45 inches, dark yellowish-brown (10YR 4/4) light silty clay loam; weak, medium, prismatic structure parting to moderate, fine, subangular blocky; friable; few fine roots; common fine and few medium tubular pores; common thin clay films on faces of peds; medium acid; clear, wavy boundary.

IIB31—45 to 51 inches, dark yellowish-brown (10YR 4/4) loam high in content of silt and very fine sand; weak, medium, subangular blocky structure; friable; few fine roots; common fine and few medium tubular pores; slightly acid; abrupt, wavy boundary.

IIB32—51 to 60 inches or more, dark-brown (7.5YR 4/4) heavy sandy loam; weak, medium, subangular blocky structure; friable; few fine roots; few fine and medium tubular pores; slightly acid.

The solum ranges from 44 to 70 inches in thickness. Depth to the till material ranges from 40 to 60 inches. The A horizon ranges from black (10YR 2/1) to dark brown (10YR 3/3) and is 9 to 20 inches thick. The B horizon is brown (7.5YR 4/4) or dark brown (10YR 3/3) to yellowish brown (10YR 5/4) and ranges from 30 to 50 inches in thickness. The B2 horizon is dominantly heavy silt loam. The average clay content is 20 to 27 percent. The B horizon is medium acid to neutral. The IIB3 horizon is sandy loam, heavy sandy loam, sandy clay loam, loam, or clay loam. In some places the B3 horizon is mottled. The C horizon is sandy loam till.

Plano soils occur with Joy, Ringwood, Ripon, Saybrook, and Troxel soils. They have better drainage than the somewhat poorly drained Joy soils. They have a thicker solum and contain more silt and less sand above a depth of 40 inches than Ringwood and Saybrook soils. Unlike Ripon soils, they are not underlain by limestone bedrock above a depth of 40 inches. They have a thinner A horizon than Troxel soils.

Plano silt loam, 0 to 2 percent slopes (PnA).—Large, irregularly shaped areas of this soil are in broad slight depressions in the till plain. The profile is similar to the one described as representative of the series, but the surface layer is 2 to 7 inches thicker, and in most areas the soil is mottled at a depth of about 35 to 50 inches.

Included with this soil in mapping are small areas of Joy silt loam, 0 to 4 percent slopes, and Troxel silt loam, 0 to 3 percent slopes. Also included are a few areas where the subsoil formed entirely in silty sediment and areas where the substratum is sand and gravel outwash.

This soil has no serious limitations for farming. In some places, water ponds in spring and after a rainfall. Runoff is slow. Use of the soil for septic tank filter fields is hazardous.

This soil is well suited to crops. Most of the acreage is cropped to corn or peas. Capability unit I; woodland group not classified; wildlife group 4.

Plano silt loam, 2 to 6 percent slopes (PnB).—This soil occurs mostly as irregularly shaped areas on the foot slopes of uplands and on rises on the till plain. Most areas are 40 to 100 acres in size. This soil has the profile described as representative of the series. In the more sloping areas, 4 to 6 inches of the original surface layer have been lost through erosion, and the present surface layer is 9 to 11 inches thick. In many areas, typically where slopes are 2 to 4 percent, the soil is mottled at a depth of about 35 to 50 inches.

Included with this soil in mapping are small areas of Plano silt loam, 0 to 2 percent slopes, and Saybrook silt loam, 2 to 6 percent slopes, eroded. Also included are a few small areas where the subsoil formed entirely in silty sediment, areas where the surface layer is loamy, areas where the substratum is sand and gravel outwash, and areas where limestone is at a depth of 50 to 60 inches.

Runoff is slow. The erosion is generally slight, but where the slope is 4 to 6 percent, the hazard is more serious if the soil is poorly managed.

This soil is well suited to crops, but erosion is a concern in some areas. Most of the acreage is cropped to corn or vegetable crops. Capability unit IIe–1; woodland group not classified; wildlife group 4.

Plano silt loam, 6 to 12 percent slopes, eroded (PnC2). This soil is on rises and the sides of ridges on the till plain. The areas are commonly long and less than 40 acres in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is a few inches thinner and the substratum typically is at a depth of 50 to 60 inches.

Included with this soil in mapping are small areas of Ringwood silt loam, 6 to 12 percent slopes, eroded, and Saybrook silt loam, 6 to 12 percent slopes, eroded. In a few areas, the surface layer is 7 to 9 inches thick.

Also included are some small areas where limestone is at a depth of 40 to 60 inches and areas where the substratum is sand and gravel outwash.

Runoff is medium. The erosion hazard is moderate. Erosion is a serious limitation.

Most of the acreage is cropped to corn, small grain, or forage. Capability unit IIIe–1; woodland group not classified; wildlife group 4.

Poygan Series

The Poygan series consists of poorly drained soils that formed in less than 20 inches of silt and the underlying calcareous, reddish clayey sediment. These soils are typically in slightly concave lake basins, but are also in low positions on broad flood plains. Slopes range from 0 to 3 percent. The native vegetation was hardwood forest and some water-tolerant grasses.

In a representative profile the surface layer is very dark gray silt loam about 10 inches thick. The subsoil is about 20 inches thick. The upper 2 inches is dark-gray, firm silty clay; the next 1 inch is gray, firm silty clay loam; the next 9 inches is weak-red, firm heavy silty clay; and the lower 8 inches is reddish-brown, firm silty clay. The substratum is reddish-brown, strongly effervescent light silty clay.

These soils are saturated at or near the surface throughout most of the year. They are subject to ponding in spring and after heavy rains. Permeability is slow. Available water capacity and fertility are high.

Many areas of these soils have been drained and are used for crops. Some undrained areas are used as pasture or woodland.

Representative profile of Poygan silt loam, 0 to 3 percent slopes, in a field of bromegrass, 585 feet east of the section line and 75 feet north of Kessner road in the SW¼NW¼ sec. 1, T. 13 N., R. 7 E.

Ap—0 to 10 inches, very dark gray (N 3/0) silt loam; few, fine, faint, dark-gray (5Y 4/1) mottles; moderate, medium, subangular blocky structure; firm, sticky, plastic; common fine roots; common fine and few medium and coarse tubular pores; about 1 percent gravel; neutral; abrupt, wavy boundary.

B1g—10 to 12 inches, dark-gray (5Y 4/1) silty clay; common, fine, faint, very dark gray (N 3/0) and gray (5Y 5/1) mottles and common, fine, prominent, reddish-brown (5YR 4/4) mottles; moderate, very fine, angular blocky structure; firm, sticky plastic; common fine roots; common fine and few medium and corase tubular pores; about 1 percent gravel; slightly acid; abrupt, wavy boundary.

B21g—12 to 13 inches, gray (5Y 6/1) silty clay loam; about 10 percent very fine sand; few, fine, prominent, yellowish-brown (10YR 5/8) and yellowish-red (5YR 4/8) mottles; moderate, very fine, subangular blocky structure; firm, sticky, plastic; few fine roots; common fine and few medium and coarse tubular pores; about 3 percent gravel; slightly acid; abrupt, wavy boundary.

IIB22g—13 to 22 inches, weak-red (2.5YR 4/2) heavy silty clay; many, fine, prominent, yellowish-red (5YR 5/8) and gray (5Y 6/1) mottles; weak, medium, prismatic structure parting to moderate, very fine, angular blocky; firm, sticky, coarse tubular pores; common thin clay films on faces of peds and continuous, moderately thick clay films in pores; mildly alkaline; clear, wavy boundary.

IIB3—22 to 30 inches, reddish-brown (5YR 4/3) silty clay; many, fine and medium, prominent, yellowish-red (5YR 5/6) and gray (5Y 6/1) mottles; moderate, medium, prismatic structure parting to fine, angular blocky; firm, sticky, slightly plastic; few fine roots; many fine and few medium tubular pores; few thin clay films on faces of peds and continuous thin clay films in pores; moderately alkaline; gradual, wavy boundary.

IIC1—30 to 58 inches, reddish-brown (5YR 5/3) light silty clay; many, fine, prominent, black (5YR 2/1) and light-gray (5Y 7/1) mottles on cleavage faces and in pores; weak, medium, platy structure parting to very fine, subangular blocky; firm, sticky, slightly plastic; few fine roots; few fine and medium tubular pores; strong effervescence; clear, wavy boundary.

IIC2—58 to 60 inches, reddish-brown (5YR 5/3) light silty clay; common, fine, prominent, light-gray (5Y 7/1) mottles; moderate, fine, platy structure; friable, sticky, slightly plastic; violent effervescence.

The solum ranges from 20 to 30 inches in thickness. It is slightly acid or neutral in the upper part and ranges from neutral to moderately alkaline in the lower part. The A horizon ranges from 8 to 12 inches in thickness and is black (N 2/0, 10YR 2/1) or very dark gray (N 3/0, 10YR 3/1). The Bg horizon ranges from silty clay loam to clay, and the weighted average clay content is estimated to range from 40 to 50 percent. In some places, the C horizon contains thin strata of silty clay loam.

The poorly drained Poygan soils are in a drainage sequence with the well drained Briggsville soils. The moderately well drained Briggsville silty subsoil variant occurs with these soils. They are wetter and contain more clay in the upper part of the B horizon than the Briggsville silty subsoil variant.

Poygan silt loam, 0 to 3 percent slopes (PoA).—Large, irregularly shaped areas of this soil are in lake basins. Some areas range up to 400 acres in size.

Included with this soil in mapping are small areas where the surface layer is silty clay loam, loam, or sandy loam. Also included are a few convex areas that have better drainage, some small areas where the clay content in the subsoil ranges from 25 to 40 percent, and a few areas where the subsoil or substratum are high in content of sand.

Runoff is very slow to ponded. There is little or no erosion hazard. Wetness and occasional ponding of water are the major limitations.

If adequately drained, this soil is well suited to most crops commonly grown in the survey area. Undrained areas are suited to pasture or woodland. Capability unit IIw–1; woodland group 3w5; wildlife group 5b.

Puchyan Series

The Puchyan series consists of well-drained and moderately well drained sandy soils. These soils formed in 20 to 40 inches of sandy sediment and the underlying silty deposits. Calcareous sandy loam glacial till commonly is at a depth of 50 inches or more. The soils are in slight depressions in upland basins, on ground moraines, and on valley terraces. Slopes range from 2 to 12 percent. The native vegetation was predominantly oak forest.

In a representative profile the surface layer is dark-brown loamy fine sand about 9 inches thick. The subsurface layer is yellowish-brown loamy fine sand about 16 inches thick. The subsoil is about 33 inches thick. The upper 7 inches is yellowish-brown, friable fine sandy loam, and the lower 26 inches is light olive-brown, friable silt loam. The substratum is light olive-brown, slightly effervescent silt loam.

These soils are droughty in the upper sandy sediment and are subject to blowing. Permeability is rapid in the upper sandy sediment and moderate in the lower silty sediment. Available water capacity and fertility are medium. In many places, these soils are saturated at a depth of about 3 to 5 feet for significant periods during wet seasons.

Most of the acreage is cultivated.

Representative profile of Puchyan loamy fine sand, 2 to 6 percent slopes, in a cornfield 135 feet east and 160 feet south of the northwest corner of SW¼SW¼ sec. 16, T. 11 N., R. 11 E.

Ap—0 to 9 inches, dark-brown (10YR 4/3) loamy fine sand; weak, medium, subangular blocky structure; very friable; common fine roots; mildly alkaline; abrupt, smooth boundary.

A2—9 to 25 inches, yellowish-brown (10YR 5/6) loamy fine sand; weak, coarse, subangular blocky structure; very friable; common fine roots; mildly alkaline; abrupt, wavy boundary.

IIB1t—25 to 32 inches, yellowish-brown (10YR 5/4) fine sandy loam; few, fine, distinct, strong-brown (7.5YR 5/6) mottles in lower few inches; weak, fine and medium, subangular blocky structure; friable; common fine roots; common thin clay bridges between mineral grains; neutral; abrupt, wavy boundary.

IIB2t—32 to 49 inches, light olive-brown (2.5Y 5/6) silt loam; few, fine, faint, brownish-yellow (10YR 6/6) mottles; few, medium, distinct, dark-brown (7.5YR 4/4) mottles; common, fine, prominent, light brownish-gray (10YR 6/2) mottles; weak, fine and medium, subangular blocky structure; friable; few fine roots; many, very thin clay bridges between mineral grains; neutral; gradual, wavy boundary.

IIB3—49 to 58 inches, light olive-brown (2.5Y 5/4) silt loam; few and common, fine, distinct, dark-brown (7.5YR 4/4) and light brownish-gray (2.5Y 6/2) mottles; weak, medium, subangular blocky structure; friable; few fine roots; slightly acid; clear, wavy boundary.

IIC—58 to 60 inches, light olive-brown (2.5Y 5/4) silt loam high in content of very fine sand; massive; very friable; slight effervescence.

The solum ranges from 36 to 60 inches in thickness. Depth to the silty deposits ranges from 20 to 40 inches. The Ap horizon is dark grayish brown (10YR 4/2), dark brown (10YR 3/3–4/3), or brown (10YR 5/3). If it occurs, the A1 horizon is commonly very dark grayish brown (10YR 3/2) and is less than 5 inches thick. The A2 horizon ranges from brown (10YR 4/3) to brownish yellow (10YR 6/6) and is loamy fine sand, loamy sand, or fine sand. The IIB1 horizon is dark-brown (7.5YR 4/4), dark yellowish-brown (10YR 4/4), or yellowish-brown (10YR 5/4) loam, sandy loam, or fine sandy loam. It ranges from about 6 to 12 inches in thickness. In some places, the IIB2 and IIB3 horizons are brown (10YR 4/3–5/3), dark yellowish brown (10YR 4/4), yellowish brown (10YR 5/4), or olive brown (2.4Y 4/4). The upper 20 inches of the B horizon is less than 18 percent clay and is 15 percent or more fine sand or coarser. Mottles commonly occur at a depth of about 30 to 50 inches.

Puchyan soils occur with Grellton and Chelsea soils. They have less clay in the upper 20 inches of the B horizon than Grellton soils. They have more silt and clay and less sand within a depth of 40 inches than Chelsea soils.

Puchyan loamy fine sand, 2 to 6 percent slopes (PuB).—Large, irregularly shaped areas of this soil are in slight depressions in the till plain. Long narrow areas are on valley terraces and on benches adjacent to wetter areas. This soil occurs in areas with Grellton soils. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of Grellton fine sandy loam, 1 to 6 percent slopes; Plainfield loamy fine sand, loamy substratum, 2 to 6 percent slopes; and Salter fine sandy loam, 2 to 6 percent slopes. Also included are a few small areas where the underlying sediment is at a depth of less than 20 inches, areas where the surface layer is fine sandy loam, nearly level areas, and a few wet spots, which are indicated by spot symbols on the soil map.

Runoff is slow. The hazard of water erosion is slight.

This soil is better suited to deep-rooted plants than to shallow-rooted plants because the underlying silty sediment contains most of the available water and nutrients. Most of the acreage is cultivated. Capability unit IIIe–4; woodland group 3o1; wildlife group 3.

Puchyan loamy fine sand, 6 to 12 percent slopes (PuC).—Long, narrow areas of this soil are on valley sides and along ridges. The substratum commonly is at a depth of about 40 to 50 inches. The lower part of the subsoil that formed in silt is commonly brown or yellowish brown and contains few, if any, mottles. In a few places, part of the surface layer has been lost through soil blowing.

Included with this soil in mapping are a few small areas of Grellton fine sandy loam, 6 to 12 percent slopes, eroded; Plainfield loamy fine sand, loamy substratum, 6 to 12 percent slopes; and Salter fine sandy loam, 6 to 12 percent slopes, eroded. Also included are a few areas where the underlying silty sediment is at a depth of less than 20 inches and many areas where the substratum is underlain at a depth of about 50 to 60 inches by sandy loam glacial till.

Runoff is medium. The hazard of water erosion is slight.

This soil is better suited to deep-rooted plants than to shallow-rooted plants because the underlying silty sediment contains most of the available water and nutrients. Most of the acreage is cropped to corn, hay, or small grain. Some is in pasture or woodland. Capability unit IVe–4; woodland group 3o1; wildlife group 3.

Ringwood Series

The Ringwood series consists of well-drained silty soils that formed in 15 to 30 inches of silty sediment and the underlying calcareous sandy loam till. These soils are on silt covered till plains. Slopes range from 1 to 12 percent. The native vegetation was grasses.

In a representative profile the surface layer is silt loam about 13 inches thick. The upper 10 inches is very dark brown, and the lower 3 inches is dark brown. The subsoil is about 19 inches thick. The upper 10 inches is dark-brown, friable light silty clay loam; the next 4 inches is dark-brown, friable sandy clay loam; and the lower 5 inches is dark-brown, very friable heavy sandy loam. The substratum is yellowish-brown, strongly effervescent sandy loam.

Permeability is moderate. Available water capacity is medium, and fertility is high.

Most of the acreage is cultivated.

Representative profile of Ringwood silt loam, 1 to 6 percent slopes, eroded, in an uneroded area 780 feet

east of Dodge road and 324 feet south of Highway 33 in NW¼NE¼ sec. 35, T. 13 N., R. 11 E.

Ap—0 to 10 inches, very dark brown (10YR 2/2) silt loam; weak, coarse, subangular blocky structure; friable; many fine roots; neutral; abrupt, smooth boundary.

A3—10 to 13 inches, dark-brown (10YR 3/3) silt loam; weak, very fine, subangular blocky structure; very friable; common fine roots; slightly acid; abrupt, wavy boundary.

B21t—13 to 23 inches, dark-brown (10YR 4/3) light silty clay loam; moderate, fine and very fine, subangular blocky structure; friable; common fine roots; common thin clay films on faces of peds; slightly acid; abrupt, wavy boundary.

IIB22t—23 to 27 inches, dark-brown (7.5YR 4/4) sandy clay loam; moderate, fine, subangular blocky structure; friable; few fine roots; common thin clay films on faces of peds; about 2 percent gravel; slightly acid; clear, wavy boundary.

IIB3t—27 to 32 inches, dark-brown (7.5YR 4/4) heavy sandy loam; weak, medium, subangular blocky structure; friable; few fine roots; few thin clay films on faces of peds; about 4 percent gravel; neutral; clear, wavy boundary.

IIC—32 to 60 inches, yellowish-brown (10YR 5/4) sandy loam; massive; friable; about 12 percent gravel; strong effervescence.

The solum typically ranges from 30 to 36 inches in thickness, but in places ranges to 45 inches. Depth to the till is typically 20 to 24 inches and ranges from 15 to 30 inches. The A horizon ranges from 10 to 16 inches in thickness. It commonly ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2). In many places there is a dark-brown (10YR 3/3) A3 horizon. The B horizon is dark-brown (10YR 4/3) to yellowish-brown (10YR 5/4) light silty clay loam, heavy silt loam, or silty clay loam. The IIB horizon is dark brown (7.5YR 4/4) or dark yellowish brown (10YR 3/4–4/4). It is commonly sandy clay loam or heavy loam, but ranges to heavy sandy loam or sandy loam in the lower part. Reaction in the Bt horizon is commonly medium acid or slightly acid but ranges to mildly alkaline in the lower part. The upper 20 inches of the Bt horizon is 18 to 30 percent clay, and 15 percent or more of the weight is fine sand or coarser.

Ringwood soils occur with Griswold, Plano, and Saybrook soils. They contain more silt and less sand in the upper part of the B horizon than Griswold soils. They contain more sand and less silt in the upper 20 inches of the Bt horizon than Plano or Saybrook soils. In addition, their solum is thinner than that of Plano soils.

Ringwood silt loam, 1 to 6 percent slopes, eroded (RdB2).—This soil is in irregular or long areas on slight rises on the till plain near Plano and Saybrook soils. The areas are commonly 30 to 60 acres in size. This soil has the profile described as representative of the series, but in most areas part of the surface layer has been lost through erosion.

Included with this soil in mapping are small areas of Saybrook silt loam, 2 to 6 percent slopes, eroded, and Griswold silt loam, 2 to 6 percent slopes, eroded. Also included are some areas where bedrock is at a depth of 40 to 60 inches, areas where the surface layer is loamy or is only 8 or 9 inches thick, and some areas where there is little or no erosion.

Runoff is slow to medium. The more sloping areas have a moderate erosion hazard. Erosion is the main limitation.

This soil is well suited to the crops commonly grown in the survey area. Most of the acreage is cultivated. Capability unit IIe–1; woodland group not classified; wildlife group 4.

Ringwood silt loam, 6 to 12 percent slopes, eroded (RdC2).—This soil is in broad and long areas along ridges and on rises on the till plain. Most areas range from 10 to 20 acres in size. This soil has a profile similar to the one described as representative of the series, but the surface layer is 9 to 11 inches thick.

Included with this soil in mapping are small areas of Griswold silt loam, 6 to 12 percent slopes, eroded, and Saybrook silt loam, 6 to 12 percent slopes, eroded. Also included are a few small areas where bedrock is at a depth of 40 to 60 inches and areas where the surface layer is only 6 to 9 inches thick.

Runoff is medium. The erosion hazard is moderate. Erosion is the major limitation.

Most of the acreage is cropped to corn or small grain. Some is cropped to hay or used as pasture. Capability unit IIIe–1; woodland group not classified; wildlife group 4.

Ripon Series

The Ripon series consists of well-drained silty soils underlain at a depth of 20 to 40 inches by limestone. These soils formed in 18 to 30 inches of silty sediment and the underlying loamy glacial till. They are on silt-covered till plains. Slopes range from 2 to 12 percent. The native vegetation was prairie grasses.

In a representative profile the surface layer is silt loam about 13 inches thick. The upper 10 inches is black, and the lower 3 inches is very dark grayish brown. The subsoil is about 25 inches thick. The upper 12 inches is dark-brown, firm silty clay loam; the next 5 inches is dark yellowish-brown, firm silty clay loam; and the lower 8 inches is brown, friable sandy loam. Limestone is at a depth of about 38 inches.

Permeability and available water capacity and fertility are medium. The limestone at a depth of 20 to 40 inches restricts many uses of these soils.

Most of the acreage is cultivated. These soils are a good source of crushed limestone.

Representative profile of Ripon silt loam, 2 to 6 percent slopes, in a cornfield 45 feet north and 325 feet east of the southwest corner of sec. 26, T. 10 N., R. 10 E.

Ap—0 to 10 inches, black (10YR 2/1) silt loam; weak, medium, subangular blocky structure; friable; common fine roots; neutral; abrupt, smooth boundary.

A3—10 to 13 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, very fine, subangular blocky structure; friable; common fine roots; medium acid; clear, wavy boundary.

B21t—13 to 25 inches, dark-brown (10YR 4/3) silty clay loam; moderate, fine, subangular blocky structure; firm; few fine roots; many thin clay films; medium acid; clear, wavy boundary.

B22t—25 to 30 inches, dark yellowish-brown (10YR 4/4) silty clay loam; weak, fine, subangular blocky structure; firm; few fine roots; many thin clay films; slightly acid; clear, wavy boundary.

IIB23t—30 to 38 inches, dark-brown (10YR 3/3) sandy loam; weak, medium, subangular blocky structure; friable; few fine roots; many thin clay bridges between mineral grains; about 14 percent gravel; slightly acid; abrupt, wavy boundary.

IIIR—38 inches, limestone.

Thickness of the solum commonly is the same as depth to bedrock, which typically is 30 to 40 inches but ranges from 20 to 40 inches. Depth to the till ranges from 18 to 30 inches. The A horizon ranges from 8 to 15 inches in thickness. The B2t horizon is heavy silt loam or silty clay loam. The IIBt horizon ranges from dark brown (10YR 3/3) to dark yellowish brown (10YR 4/4) or is dark brown (7.5YR 4/4). It is sandy loam, heavy sandy loam, sandy clay loam, loam, or clay loam. The upper 20 inches of the B horizon is less than 15 percent sand coarser than very fine. Reaction in the B horizon is commonly slightly acid or medium acid, but ranges to mildly alkaline in the lower part.

The Ripon soils in this survey area have more sand in the lower part of the B horizon than is defined as the range for the series.

Ripon soils occur with Channahon, Plano, and Saybrook soils. They are deeper over bedrock than Channahon soils. They are shallower over bedrock than Saybrook soils.

Ripon silt loam, 2 to 6 percent slopes (ReB).—This soil is in irregularly shaped areas on rises and on crests along ridges on the till plain. Areas are commonly 20 to 40 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Channahon silt loam, 2 to 6 percent slopes. Also included are a few small areas where the lower part of the subsoil is mottled, areas where the silt mantle is less than 18 inches thick, areas where the bedrock is at a depth of more than 40 inches, nearly level areas, areas where part of the surface layer has been lost through erosion, and a few quarries, which are indicated by spot symbols on the soil map.

Runoff is slow. The erosion hazard is slight. Bedrock restricts roots and the use of this soil for septic tank filter fields.

This soil is well suited to the crops commonly grown in the survey area. Most of the acreage is cultivated. Capability unit IIe–2; woodland group not classified; wildlife group 4.

Ripon silt loam, 6 to 12 percent slopes, eroded (ReC2). This soil is in irregularly shaped or long areas on rises and along ridges on the till plain. Areas are commonly less than 30 acres in size. Bedrock commonly is at a depth of 20 to 30 inches. The surface layer is 8 to 11 inches thick. The part of the subsoil that formed in till is 2 to 6 inches thick and is commonly sandy clay loam.

Included with this soil in mapping are a few small areas of Channahon silt loam, 6 to 12 percent slopes, eroded. Also included are a few areas where the silt mantle is less than 18 inches thick, areas where bedrock is at a depth of more than 40 inches, a few outcrops of bedrock, and a few quarries, which are indicated by spot symbols on the soil map. In the more eroded spots, the surface layer is mixed with material from the subsoil.

Runoff is medium. The erosion hazard is moderate. Bedrock restricts roots and the use of this soil for septic tank filter fields.

Most of the acreage is cultivated. Some is used as pasture. Capability unit IIIe–2; woodland group not classified; wildlife group 4.

Rock Land

Rock land (Rk) is well drained and steep and very steep. It is along ridges on uplands in the western and southwestern part of the county. It is about 50 to 80 percent outcrops and 20 to 50 percent soils shallow over bedrock. Outcrops are quartzite, limestone, or sandstone. In some areas of sandstone and limestone outcrops, the sandstone outcrops at the lower elevations. Slopes are uniform and convex and range from 12 to 75 percent, but are commonly 35 to 55 percent. The soil material is generally loamy, but in places is sandy or silty. Generally, it is less than 20 inches deep. It contains pieces of rock that ordinarily are 5 to 15 inches in diameter, but range from 1 inch to more than 10 feet. Areas of quartzite bedrock are mainly exposed quartzite faces and soil material, which contains few pieces of rock.

Included in mapping are small areas of Baraboo silt loam, 20 to 30 percent slopes; Channahon silt loam, 12 to 30 percent slopes, eroded; and Northfield sandy loam, 12 to 30 percent slopes.

Rock land is seasonally droughty. Runoff is very rapid.

The plant cover is a sparse growth of scrub oak or juniper and grasses (fig. 18). In places, the northern slopes support good stands of hardwoods. Most of the acreage is used as limited pasture or wildlife habitat. Capability unit VIIIs–10; woodland group 4d2; wildlife group 8.

Rodman Series

The Rodman series consists of excessively drained gravelly or very gravelly loamy soils underlain at a depth of about 6 to 12 inches by calcareous sand and gravel outwash. These soils are on kames, eskers, and moraines on the outwash plain. Slopes are commonly 20 to 45 percent, but range from 2 to 45 percent.

In a representative profile the surface layer is very dark grayish-brown gravelly loam about 3 inches thick. The subsoil is dark-brown, very gravelly loam about 4 inches thick. The substratum is yellowish-brown, slightly effervescent gravel and sand.

These soils are droughty and susceptible to water erosion if the plant cover is removed. Permeability is very rapid. Available water capacity is very low, and fertility is low. Roots are restricted by the sand and gravel substratum. The gravel in the surface layer and subsoil interferes with tillage.

Most of the acreage is in woodland or pasture. In many places, the underlying sand and gravel is mined. The common small gravel pits are indicated by spot symbols on the soil map.

Representative profile of Rodman gravelly loam, 20 to 45 percent slopes, 600 feet east and 30 feet south of the northwest corner of SW¼ sec. 2, T. 13 N., R. 9 E.

Ap—0 to 3 inches, very dark grayish-brown (10YR 3/2) gravelly loam; moderate, very fine, subangular blocky structure; very friable; many fine roots; about 15 percent gravel; neutral; abrupt, wavy boundary.

B—3 to 7 inches, dark-brown (7.5YR 4/4) very gravelly loam; weak, fine, subangular blocky structure; friable; common fine roots; about 70 percent gravel; mildly alkaline; abrupt, wavy boundary.

C—7 to 60 inches, yellowish-brown (10YR 5/4) gravel and sand; single grained; loose; slight effervescence.

Figure 18.—Juniper trees on Rock land.

The solum is typically 5 to 8 inches thick. It is neutral or mildly alkaline and is about 15 to 75 percent gravel. The A horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2) in color and from about 2 to 6 inches in thickness. The B horizon is dark-brown (7.5YR 4/4), brown (7.5YR 5/4 or 10YR 4/3), or dark yellowish-brown (10YR 3/4–4/4) gravelly or very gravelly loam or sandy loam. It ranges from about 4 to 6 inches in thickness. Content of gravel in the C horizon ranges from about 15 to 80 percent. In some places, this horizon has a high content of cobblestones.

The Rodman soils in this survey area have a thinner solum than is defined as the range for the series.

Rodman soils occur with Lorenzo soils. Their solum is not so thick as that of Lorenzo soils (fig. 19) and commonly contains more gravel.

Rodman gravelly loam, 2 to 12 percent slopes (RoC).—Small, roughly circular or long areas of this soil are on knolls and rises on the outwash plain. Areas are commonly 5 to 10 acres in size. The surface layer is black or very dark brown gravelly loam about 3 to 6 inches thick. The thickness of the surface layer and subsoil combined is commonly about 10 inches.

Included with this soil in mapping are small areas of Lorenzo loam, 2 to 6 percent slopes, and Lorenzo loam, 6 to 12 percent slopes, eroded. Also included are a few areas where the sand and gravel substratum is just below the surface layer, areas where the surface layer is gravelly sandy loam, and areas where the substratum is mostly medium and coarse sand.

Runoff is medium. The erosion hazard is moderate.

This soil is a good source of sand and gravel. Most of the acreage is in woodland or pasture. The use of this soil for crops is limited by very low available water capacity, low fertility, a shallow root zone, poor tilth, and the hazard of erosion. Capability unit VIs–5; woodland group 4f1; wildlife group 8.

Rodman gravelly loam, 12 to 20 percent slopes (RoD).—Small, long areas of this soil are on rises on the outwash plain. Areas are commonly 5 to 10 acres in size. A few spots are eroded.

Included with this soil in mapping are small areas of Lorenzo loam, 12 to 20 percent slopes, eroded. Also included are a few small areas where the substratum is mostly sand, areas where the substratum is just below the surface layer, and areas where the surface layer is sandy loam.

Runoff is rapid. The erosion hazard is severe.

This soil is poorly suited to cultivated crops but is a good source of sand and gravel. Most of the acreage is in woodland or permanent pasture. Capability unit VIs–5; woodland group 4f2; wildlife group 8.

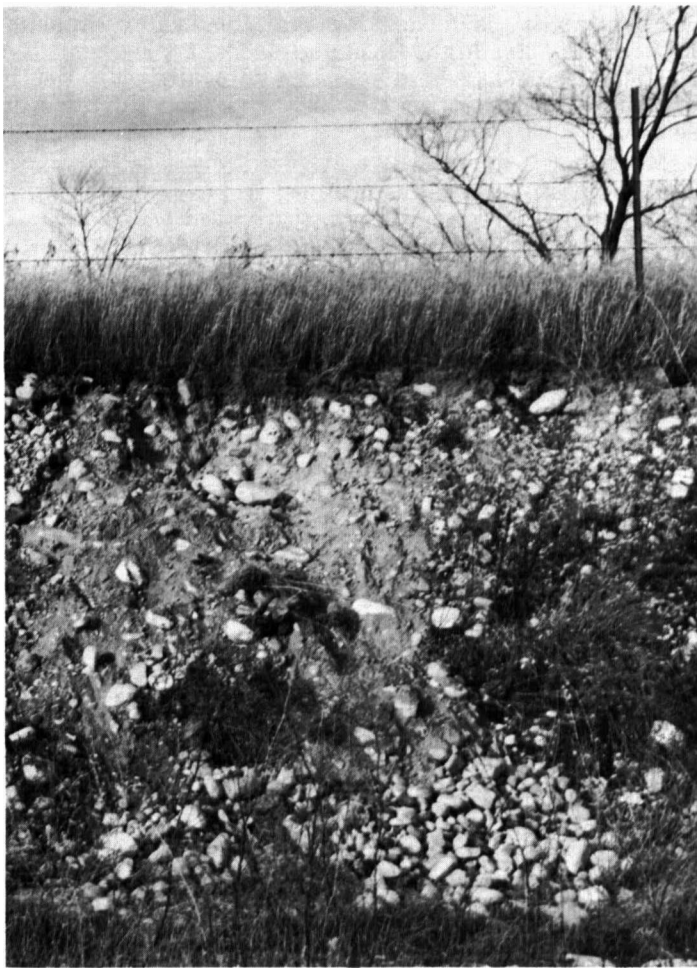

Figure 19.—Rodman soil, too shallow and droughty to be suitable for crops, is a good source of sand and gravel.

Rodman gravelly loam, 20 to 45 percent slopes (RoE).—This soil is in long and narrow or irregularly shaped areas along ridges, on eskers, and on hilly topography on the outwash plain. Areas are commonly 5 to 20 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas where the surface layer is sandy loam or loamy sand, areas where the substratum is mostly sand, areas where the substratum is just below the surface layer, and areas where the thickness of the surface layer and subsoil combined is more than 12 inches. In a few places part of the surface layer has been lost through erosion.

Runoff is very rapid. The erosion hazard is very severe.

This soil is a good source of sand and gravel. Most of the acreage is in woodland. Capability unit VIIs–5; woodland group 4f2; wildlife group 8.

Rotamer Series

The Rotamer series consists of well-drained loamy soils. These soils formed in calcareous sandy loam glacial till. They are on moraines and drumlins and along ridges on the till plain. Slopes range from 2 to 30 percent. The native vegetation was mostly deciduous forest.

In a representative profile the surface layer is very dark brown loam about 9 inches thick. The subsoil is dark yellowish-brown, friable sandy clay loam about 6 inches thick. The substratum is yellowish-brown, strongly effervescent gravelly sandy loam.

These soils tend to be droughty. Permeability is moderate. Available water capacity and fertility are medium.

Areas of these soils are cropped to corn and legumes. Many areas are in pasture or woodland.

Representative profile of Rotamer loam, 2 to 6 percent slopes, 144 feet south and 631 feet east of the northwest corner of NE¼NW¼ sec. 13, T. 12 N., R. 11 E.

Ap—0 to 9 inches, very dark brown (10YR 2/2) loam; weak, fine and medium, subangular blocky structure; friable; common fine roots; about 3 percent gravel; neutral; abrupt, smooth boundary.

B2t—9 to 15 inches, dark yellowish-brown (10YR 3/4) heavy sandy loam; weak, medium, subangular blocky structure; friable; common fine roots; about 10 percent gravel; common thin clay films; mildly alkaline; abrupt, wavy boundary.

C—15 to 60 inches, yellowish-brown (10YR 5/4) gravelly sandy loam; massive; friable; few fine roots; about 20 percent gravel; strong effervescence.

The solum typically is 12 to 15 inches thick but in places ranges to 24 inches. The A and B horizons are as much as 14 percent gravel. The Ap horizon is very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2) and is 6 to 9 inches thick. The B2t horizon is dark brown (7.5YR 4/4 or 10YR 3/3–4/3) or dark yellowish brown (10YR 3/4–4/4) and ranges from 6 to 12 inches in thickness. It is typically heavy sandy loam, but in some places it contains individual horizons of sandy loam or sandy clay loam. Content of clay ranges from about 15 to 18 percent.

The Rotamer soils in this survey area contain less clay in the Bt horizon than is defined as the range for the series.

Rotamer soils occur with Lapeer soils. They have a thinner solum than those soils.

Rotamer loam, 2 to 6 percent slopes (RtB).—This soil is in irregularly shaped or somewhat long areas on rises and crests of rises on the till plain. Areas range from 30 to 60 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few areas of Lapeer fine sandy loam, 2 to 6 percent slopes, and areas where the surface layer is silt loam or fine sandy loam. Also included are a few areas where the substratum is loamy sand till, a few nearly level areas, and areas of eroded soils.

Runoff is slow. The erosion hazard is slight.

This soil is suited to the crops commonly grown in the survey area. Most of the acreage is cultivated. Capability unit IIIe–4; woodland group not classified; wildlife group 4.

Rotamer loam, 6 to 12 percent slopes, eroded (RtC2).—This soil is in long and somewhat narrow areas along ridges and on the sides and crests of drumlins on the till plain. Areas range from 10 to 40 acres in size. The surface layer is 6 to 8 inches thick.

Included with this soil in mapping are some small areas of Lapeer fine sandy loam, 6 to 12 percent slopes, eroded, and areas of soils that have a surface layer of silt loam or fine sandy loam. Also included are a few

areas where the substratum is loamy sand till, and some more eroded spots where subsoil material is exposed at the surface.

Runoff is medium. The erosion hazard is moderate.

This soil is commonly cropped to hay and some corn. It is poorly suited to intensive cultivation. Most of the acreage is cultivated. Some is used as pasture or woodland. Capability unit IVe–4; woodland group not classified; wildlife group 4.

Rotamer loam, 12 to 20 percent slopes, eroded (RtD2).—This soil is in long, narrow areas along ridges and on the sides and crests of drumlins on the till plain. Areas range up to 30 acres in size.

Included with this soil in mapping are small areas of Lapeer fine sandy loam, 12 to 30 percent slopes, eroded; areas of soils that have a surface layer of fine sandy loam; and some areas where the substratum is loamy sand till. Also included are severely eroded spots, indicated by spot symbols on the soil map, where subsoil material is exposed at the surface.

Runoff is rapid. The erosion hazard is severe.

This soil is in pasture or hay. It is poorly suited to cultivated crops. Most of the acreage is cultivated or has been cultivated. Some is forested. Capability unit VIe–4; woodland group not classified; wildlife group 4.

Rotamer loam, 20 to 30 percent slopes, eroded (RtE2). This soil is in long, narrow areas along ridges on the till plain. Areas are less than 15 acres in size. The surface layer is 1 to 3 inches thick. In some convex areas, the original surface layer has been lost through erosion, and subsoil material is exposed at the surface.

Included with this soil in mapping are small areas of Lapeer fine sandy loam, 20 to 30 percent slopes, eroded. Also included are more eroded spots, where limy substratum material is exposed at the surface and a few places where the substratum is loamy sand till.

Runoff is very rapid. The erosion hazard is very severe.

This soil is poorly suited to cultivated crops. Most of the acreage is used as pasture. Capability unit VIIe–4; woodland group not classified; wildlife group 4.

St. Charles Series

The St. Charles series consists of well drained and moderately well drained silty soils. These soils formed in 40 to 60 inches of silty sediment and the underlying calcareous sandy loam glacial till. They occur on silt-covered till plains. Slopes are typically 0 to 12 percent but range up to 30 percent. The native vegetation was deciduous forest.

In a representative profile the surface layer is very dark grayish-brown silt loam about 9 inches thick. The subsoil is about 49 inches thick. The upper 2 inches is dark-brown, friable heavy silt loam; the next 24 inches is dark yellowish-brown, friable and firm silty clay loam; the next 12 inches is dark yellowish-brown, friable silt loam; and the lower 11 inches is dark-brown, friable sandy clay loam. The substratum is yellowish-brown, very friable, moderately alkaline sandy loam.

Permeability is moderate. Available water capacity and fertility are high. In many places, typically in the less sloping areas, these soils are saturated at a depth of about 3 to 5 feet for significant periods during wet seasons.

Most of the acreage is cultivated. Corn is the main crop, but some areas are cropped to peas, small grain, or hay. The more sloping areas are used as pasture or woodland. The less sloping areas are well suited to crops.

Representative profile of St. Charles silt loam, 2 to 6 percent slopes, eroded, 610 feet north and 240 feet west of the southeast corner of sec. 30, T. 10 N., R. 12 E.

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; weak, very fine, subangular blocky structure; friable; common fine roots; neutral; abrupt, smooth boundary.

B1t—9 to 11 inches, dark-brown (10YR 4/3) heavy silt loam; weak, very fine, subangular blocky structure; friable; few fine roots; common fine and few medium and coarse tubular pores; very dark grayish-brown (10YR 3/2) material in coarse pores; few thin clay films on faces of peds; slightly acid; clear, wavy boundary.

B21t—11 to 26 inches, dark yellowish-brown (10YR 4/4) silty clay loam; strong, fine and very fine, subangular blocky structure; firm; few fine roots; many fine and few medium tubular pores; continuous thin clay films of faces of peds; slightly acid; clear, wavy boundary.

B22t—26 to 35 inches, dark yellowish-brown (10YR 4/4) silty clay loam; common, fine, faint, yellowish-brown (10YR 5/4) mottles and few, fine, distinct and prominent, brownish-yellow (10YR 6/6) and reddish-black (10R 2/1) mottles at a depth of 30 to 35 inches; moderate, fine, subangular blocky structure; friable; few fine roots; common fine and few medium tubular pores; continuous thin clay films on faces of peds; slightly acid; gradual, wavy boundary.

B31t—35 to 47 inches, dark yellowish-brown (10YR 4/4) silt loam; common, fine, prominent, strong-brown (7.5YR 5/8) mottles and few, fine, prominent, reddish-black (10R 2/1) and yellowish-red (5YR 4/8) mottles; weak, very fine, subangular blocky structure; friable; few fine roots; common fine tubular pores; common thin clay films on faces of peds; slightly acid; abrupt, wavy boundary.

IIB32—47 to 58 inches, dark-brown (7.5YR 4/4) sandy clay loam; few, fine, prominent, yellowish-red (5YR 4/8) mottles; weak, coarse, subangular blocky structure; friable; many thin clay bridges between mineral grains; about 4 percent gravel; neutral; clear, wavy boundary.

IIC—58 to 60 inches, yellowish-brown (10YR 5/4) sandy loam; massive; very friable; about 8 percent gravel; moderately alkaline; slight effervesence.

The solum ranges from 44 to more than 65 inches in thickness. Depth to the till ranges from 40 to 60 inches. The Ap horizon is dark grayish brown (10YR 4/2) or very dark grayish brown (10YR 3/2) and is 5 to 9 inches thick. The B horizon is dark brown (7.5YR 4/4) or dark brown (10YR 4/3) to yellowish brown (10YR 5/4) and ranges from 30 to 50 inches in thickness. The estimated clay content ranges from about 23 to 32 percent. The IIB3 horizon is sandy loam, sandy clay loam, or loam. Reaction in the B horizon is commonly medium acid or slightly acid but ranges to neutral in the lower part. In some places, mottles do not occur between depths of about 30 and 50 inches. The C horizon is sandy loam or heavy sandy loam glacial till.

The St. Charles soils in this survey area are less acid than is defined as the range for the series.

The well drained and moderately well drained St. Charles soils occur in a drainage sequence with the somewhat poorly drained Atterberry soils and the poorly drained Ossian soils. They also occur with Dodge and Knowles soils and are similar to Seaton soils. Their A horizon contains less organic matter than that of Atterberry and Ossian soils, and is not so thick. Unlike Atterberry and Ossian soils, the lower part of their B horizon formed in sandy loam till. They formed in thicker deposits of silt than Dodge soils. Unlike Knowles soils, they are not underlain by bedrock within a depth of 40 inches. They have more clay in the B horizon than Seaton soils, and unlike those soils, they have contrasting texture in the lower part of the B horizon.

St. Charles silt loam, 0 to 2 percent slopes (SaA).—Large, irregularly shaped areas of this soil are in slight depressions in the till plains. The profile of this soil is similar to the one described as representative of the series, but the silty sediment is typically 55 to 60 inches thick, and the subsoil extends to a depth of more than 60 inches.

Included with this soil in mapping are small areas of Atterberry silt loam, 0 to 2 percent slopes. Also included are many areas where the silty sediment is more than 60 inches thick, a few areas where the substratum is sand and gravel outwash, areas where the surface layer is 10 to 11 inches thick, areas where the subsoil contains less clay, areas where the surface layer is loamy, and areas where limestone is at a depth of 50 to 60 inches.

This soil is poorly suited as a septic tank filter field. Runoff is slow, and there is little or no erosion hazard. Water is likely to pond in spring and after rains.

This soil has few limitations and is suited to intensive cropping. Most of the acreage is cropped to corn or vegetable crops. Capability unit I; woodland group 1o1; wildlife group 1.

St. Charles silt loam, 2 to 6 percent slopes, eroded (SaB2).—This soil is on rises on the till plain near Dodge and Atterberry soils. The broad, irregularly shaped areas are large, ranging up to several hundred acres in size. This soil has the profile described as representative of the series. In the more sloping areas, 2 to 5 inches of the original surface layer has been lost through erosion and the subsoil generally is not mottled.

Included with this soil in mapping are small areas of St. Charles silt loam, 0 to 2 percent slopes, and Atterberry silt loam, 2 to 6 percent slopes. Also included are a few areas where the silty sediment extends to a depth of more than 60 inches, areas where the substratum is sand and gravel outwash, areas where the surface layer is darker colored or is loamy, areas where limestone is at a depth of about 40 to 60 inches, and areas, mainly where slopes are 2 to 4 percent, where there is little or no erosion.

Runoff is medium. The erosion hazard is moderate in the more sloping areas.

This soil is well suited to crops if properly managed to control erosion (fig. 20). It is also suited to pasture and woodland. Most of the acreage is cropped to corn or vegetable crops. Capability unit IIe–1; woodland group 1o1; wildlife group 1.

St. Charles silt loam, 6 to 12 percent slopes, eroded (SaC2).—This soil is generally in long areas on the sides of ridges and on rises on the till plain and in valleys adjacent to drainageways. Areas range from 20 to 60 acres in size. This soil is not mottled in the lower part of the subsoil; the thickness of the surface layer and subsoil combined is 44 to about 50 inches; and the surface layer is dark grayish brown and about 6 to 7 inches thick.

Included with this soil in mapping are small areas of Dodge silt loam, 6 to 12 percent slopes, eroded. Also included are a few areas where bedrock is at a depth of 40 to 60 inches and areas where the substratum is sand and gravel outwash.

Runoff is medium. The erosion hazard is moderate.

Most of the acreage is cropped to corn, small grain, or hay. Some is pastured or forested. Erosion is the major limitation. Capability unit IIIe–1; woodland group 1o1; wildlife group 1.

St. Charles silt loam, 12 to 20 percent slopes, eroded (SaD2).—This soil is in long and somewhat narrow areas along ridges or on valley sides on till plains. Areas range from 10 to 30 acres in size. In most areas the surface layer is black or very dark gray and 2 or 3 inches thick, and the subsurface layer is brown or pale brown and 5 to 9 inches thick. This soil is not mottled in the lower part of the subsoil; the thickness of the surface layer and subsoil combined is about 44 to 50 inches; and the silt sediment is 40 to 45 inches thick.

Included with this soil in mapping are small areas of Dodge silt loam, 12 to 20 percent slopes, eroded. Also included are a few severely eroded spots and gullies, which are indicated by spot symbols on the soil map.

Runoff is rapid. The erosion hazard is severe.

This soil is generally not well suited to cultivated crops. Most of the acreage is used as pasture or woodland. Capability unit IVe–1; woodland group 1r2; wildlife group 1.

St. Charles silt loam, 20 to 30 percent slopes (SaE).—This soil is along ridges on till plains. Some areas are irregularly shaped, but most are long and have short slopes. Areas are less than 40 acres in size. This soil is not mottled in the lower part of the subsoil; the thickness of the surface layer and subsoil combined is 44 to 50 inches; the silty sediment is 40 to 45 inches thick; the surface layer is black and is 1 to 3 inches thick; and the subsurface layer is brown or pale brown and is 5 to 9 inches thick.

Included with this soil in mapping are small areas of soils that have less than 40 inches of silty sediment, more than 60 inches of silty sediment, or steeper slopes. In some areas the subsoil formed entirely in silt, or it contains less clay and a high content of fine sand. Also included are a few small areas where the substratum is stratified silt and sand and the lower part of the subsoil is mottled. Some gullies have formed which are indicated by spot symbols on the soil map.

Runoff is very rapid. The erosion hazard is very severe.

This soil is poorly suited to cultivated crops. Most of the acreage is in deciduous trees. A few areas are pastured. Capability unit VIe–1; woodland group 1r2; wildlife group 1.

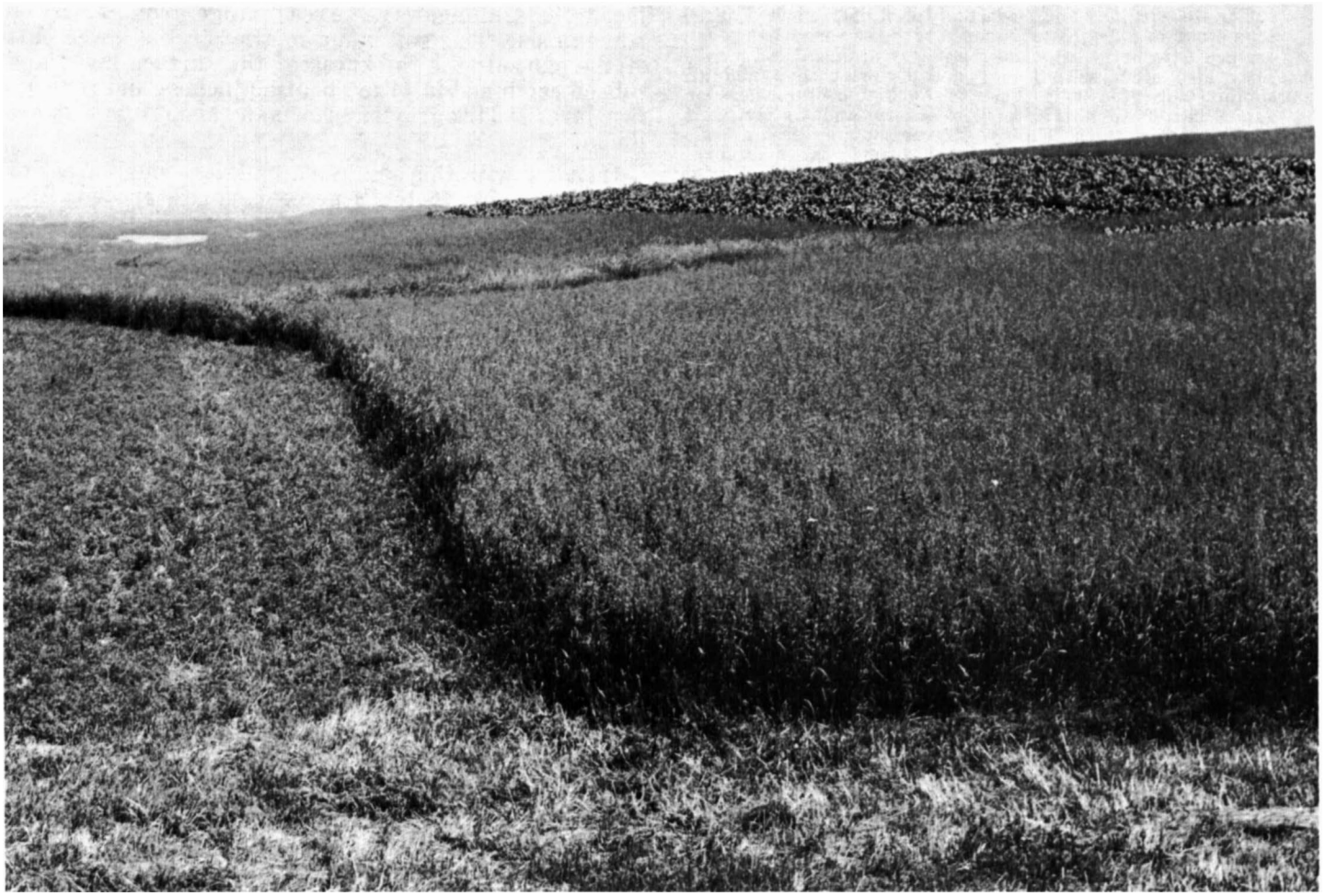

Figure 20.—**Stripcropping on St. Charles soil is effective in reducing the erosion hazard.**

Salter Series

The Salter series consists of well-drained loamy soils. These soils formed in stratified deposits of silt, fine sand, and very fine sand containing thin layers or lenses of finer or coarser textured sediment. They are on terraces, lake plains, outwash plains, and flood plains and along valley sides on uplands. Slopes are commonly 0 to 12 percent and range up to 20 percent. The native vegetation was deciduous forest.

In a representative profile the surface layer is very dark brown fine sandy loam about 4 inches thick. The subsurface layer is brown fine sandy loam about 4 inches thick. The subsoil is about 31 inches thick. The upper 16 inches is yellowish-brown, friable very fine sandy loam; the next 8 inches is dark yellowish-brown, friable fine sandy loam; the next 4 inches is dark-brown, very friable loamy fine sand; and the lower 3 inches is strong-brown, friable fine sandy loam. The substratum is strong-brown, slightly acid, stratified fine sandy loam and loam and thin strata of silt.

These soils are somewhat droughty. Permeability is moderate. Available water capacity and fertility are medium.

These soils are used for general farming.

Representative profile of Salter fine sandy loam, 6 to 12 percent slopes, eroded, in an uneroded area 20 feet east and 660 feet south of the northwest corner of NE¼ sec. 34, T. 12 N., R. 12 E.

A1—0 to 4 inches, very dark brown (10YR 2/2) fine sandy loam; weak, very fine, subangular blocky structure; very friable; many fine roots; medium acid; abrupt, wavy boundary.

A2—4 to 8 inches, brown (10YR 4/3) fine sandy loam; weak, medium, platy structure; very friable; common fine roots; medium acid; abrupt, wavy boundary.

B1—8 to 24 inches, yellowish-brown (10YR 5/4) very fine sandy loam; weak, medium, subangular blocky structure; friable; common fine roots; medium acid; clear, wavy boundary.

B21—24 to 32 inches, dark yellowish-brown (10YR 4/4) fine sandy loam; weak, medium, subangular blocky structure; friable; few fine roots; medium acid; clear, wavy boundary.

B22—32 to 36 inches, dark-brown (7.5YR 4/4) loamy fine sand; weak, coarse, subangular blocky structure; very friable; few fine roots; slightly acid; abrupt, wavy boundary.

B3—36 to 39 inches, strong-brown (7.5YR 5/6) fine sandy loam; weak, coarse, subangular blocky structure; friable; few fine roots; very few thin clay films; slightly acid; abrupt, wavy boundary.

C—39 to 60 inches, strong-brown (7.5YR 5/6) stratified fine

sandy loam and loam and thin strata of silt; massive; firm; slightly acid.

The solum commonly ranges from 30 to 40 inches in thickness, but in places ranges from 24 to 40 inches. Depth to carbonates is more than 40 inches. Reaction in the solum is slightly acid or medium acid. The A1 horizon is very dark brown or very dark grayish brown and is 1 to 4 inches thick. In tilled areas, there is an Ap horizon of very dark grayish-brown (10YR 3/2) to brown (10YR 5/3) fine sandy loam 6 to 9 inches thick. The A2 horizon ranges from brown (10YR 4/3) to pale brown (10YR 6/3) in color and from 0 to 6 inches in thickness. The B horizon is 30 percent or more, by weight, fine sand or coarser particles and less than 15 percent clay. Thickness and sequence of strata of silt, very fine sand, and fine sand are variable. A distinguishing feature of these soils is stratification of medium-textured and coarse-textured sediment in the B horizon, the C horizon, or both, above a depth of 40 inches.

The Salter soils in this survey area are more acid and contain less clay than is defined as the range for the series.

Salter soils occur with Sisson and Yahara soils and are similar to Salter variant. They have less clay in the B horizon than Sisson soils. They are not so wet as Yahara soils. They have a thinner A1 horizon that contains less organic matter than that of Yahara soils and the Salter variant.

Salter fine sandy loam, 0 to 2 percent slopes (SbA).—Irregularly shaped or long areas of this soil are on terraces, on flood plains, in lake basins, and on valley floors. Areas are commonly less than 30 acres in size. The surface layer is very dark grayish brown, dark grayish brown, or dark brown and is 8 or 9 inches thick. In most places, the subsurface layer has been incorporated into the plow layer.

Included with this soil in mapping are small areas of Chelsea loamy fine sand, 1 to 6 percent slopes; Puchyan loamy fine sand, 2 to 6 percent slopes; and Sisson fine sandy loam, 0 to 2 percent slopes. Also included are a few areas that are seasonally saturated at a depth of about 3 to 5 feet, areas where the surface layer is loamy fine sand, and areas where the subsoil and substratum are stratified loamy fine sandy and fine or very fine sandy loam.

Runoff is very slow. The erosion hazard is slight.

This soil has good potential for growing special crops under irrigation. Most of the acreage is cultivated. Some is in woodland or pasture. Droughtiness is a limitation. Capability unit IIIs–4; woodland group 1o1; wildlife group 1.

Salter fine sandy loam, 2 to 6 percent slopes (SbB).—Large, irregularly shaped or long areas of this soil are on terraces, lake plains, and valley sides, and on the sides of depressions in uplands. This soil has a few wet spots and sand spots, which are indicated by spot symbols on the soil map. The surface layer is dark grayish brown or dark brown and is 8 or 9 inches thick. In some convex areas, part of the surface layer has been lost through erosion.

Included with this soil in mapping are small areas of Chelsea loamy fine sand, 1 to 6 percent slopes; Puchyan loamy fine sand, 2 to 6 percent slopes; and Sisson fine sandy loam, 2 to 6 percent slopes. Also included are some spots where the subsoil and substratum are mostly fine sand that has a few loamy bands, some nearly level areas, some areas where the lower part of the subsoil is seasonally saturated, and some areas where the surface layer is loamy fine sand.

Runoff is slow. The erosion hazard is slight. Tilth is good.

This soil has good potential for growing special crops under irrigation. Most of the acreage is cropped to corn, small grain, or hay. Some is in woodland and pasture. Growth of crops is restricted by droughtiness. Capability unit IIIs–4; woodland group 1o1; wildlife group 1.

Salter fine sandy loam, 6 to 12 percent slopes, eroded (SbC2).—This soil is in long areas along valley sides and rises on uplands. Areas range up to 80 acres in size. This soil has the profile described as representative of the series, but in tilled areas part of the original surface layer has been lost through erosion, and the present layer is a mixture of the original material, the subsurface layer, and material from the upper part of the subsoil. The present surface layer is commonly dark brown and only about 6 or 7 inches thick.

Included with this soil in mapping are small areas of Chelsea loamy fine sand, 6 to 12 percent slopes, and Puchyan loamy fine sand, 6 to 12 percent slopes. Also included are some small areas where the surface layer is loamy fine sand, areas where the subsoil is mostly fine sand that has a few thin bands of loamy material, and areas where loamy glacial till is at a depth of about 40 to 60 inches.

Runoff is medium. The erosion hazard is moderate.

In tilled areas this soil is commonly cropped to hay. Most of the acreage is in pasture or woodland. Capability unit IIIe–7; woodland group 1o1; wildlife group 1.

Salter fine sandy loam, 12 to 20 percent slopes, eroded (SbD2).—Small, long areas of this soil are along valley sides and rises on moraines. The areas are commonly less than 15 acres in size. A few gullies have formed, and they are indicated by spot symbols on the soil map. The surface layer is very dark grayish-brown fine sandy loam 1 to 3 inches thick. The thickness of the surface layer and subsoil combined is commonly 24 to 30 inches.

Included with this soil in mapping are small areas of Plainfield loamy fine sand, loamy substratum, 12 to 25 percent slopes. Also included are some spots where slopes are more than 20 percent, areas where the surface layer is loamy fine sand, areas where the subsoil is mostly loamy fine sand or fine sand stratified with fine sandy loam, and areas where loamy glacial till is at a depth of 40 to 60 inches.

This soil is unstable and highly erodible. Runoff is medium. The erosion hazard is severe.

This soil is poorly suited to cultivated crops. It is mainly in woodland or pasture. Capability unit IVe–7; woodland group 1r2; wildlife group 1.

Salter Variant

The Salter variant consists of well drained and moderately well drained loamy soils. These soils formed in stratified deposits of silt, fine sand, and very fine sand containing thin layers or lenses of finer or coarser textured sediment. They occupy terraces, valley floors, and broad upland basins. Slopes range from 1 to 6 percent. The native vegetation was mixed grasses.

In a representative profile the surface layer is fine sandy loam about 23 inches thick. The upper 9 inches is black, the next is very dark brown, and the lower 5 inches is dark brown. The subsoil is friable fine sandy loam about 27 inches thick. The upper 17 inches is dark yellowish brown, and the lower 10 inches is dark brown. The substratum is brown, slightly acid silt loam thinly stratified with fine sandy loam and loamy fine sand.

Permeability is moderate, available water capacity is medium, and fertility is high. In some areas these soils are saturated at a depth of about 3 to 5 feet for significant periods during wet seasons.

Most of the acreage is cultivated.

Representative profile of Salter fine sandy loam, dark surface variant, 1 to 6 percent slopes, in a cornfield 150 feet south and 90 feet east of the northwest corner of SE¼NW¼ sec. 20, T. 12 N., R. 12 E.

Ap—0 to 9 inches, black (10YR 2/1) fine sandy loam; weak, coarse, subangular blocky structure; friable; common fine roots; neutral; clear, smooth boundary.

A12—9 to 18 inches, very dark brown (10YR 2/2) fine sandy loam; weak, fine, subangular blocky structure; very friable; common fine roots; slightly acid; clear, wavy boundary.

A3—18 to 23 inches, dark-brown (10YR 3/3) fine sandy loam; weak, medium, subangular blocky structure; friable; common fine roots; medium acid; clear, wavy boundary.

B2—23 to 40 inches, dark yellowish-brown (10YR 4/4) fine sandy loam; weak, fine, subangular blocky structure; friable; common fine roots; slightly acid; clear, wavy boundary.

B3—40 to 50 inches, dark-brown (7.5YR 4/4) fine sandy loam; weak, coarse, subangular blocky structure; friable; common fine roots; few thin clay films; slightly acid; clear, wavy boundary.

IIC—50 to 60 inches, brown (10YR 5/3) silt loam with thin strata of fine sandy loam and loamy fine sand; few, fine and medium, faint and prominent, light brownish-gray (10YR 6/2) and yellowish-brown (10YR 5/6) mottles; massive; friable; slightly acid.

The solum ranges from 30 to 50 inches in thickness. Depth to carbonates is more than 40 inches. The Ap or A1 horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2). The A3 horizon does not always occur. Total thickness of A horizon ranges from 10 to 24 inches. The B horizon is brown (10YR 4/3 or 5/3) or yellowish brown (10YR 5/4) in some places. It is 30 percent or more, by weight, fine sand or coarser and less than 18 percent clay. Content of silt and very fine sand in the B horizon varies vertically and also between areas. Reaction is medium acid or slightly acid. A distinguishing feature of these soils is stratification of medium-textured and coarse-textured sediment in the B horizon, the C horizon, or both, above a depth of 50 inches.

Salter variant soils occur with Friesland soils and are similar to Salter and Sparta soils. They have less clay in the B horizon than Friesland soils. Their A horizon is thicker and contains more organic matter than that of Salter soils. They have more silt and clay and less sand in the B horizon than Sparta soils.

Salter fine sandy loam, dark surface variant, 1 to 6 percent slopes (ScB).— Large, irregularly shaped areas of this soil are in basins in the uplands near Friesland soils. Some areas are on valley floors and terraces. There are a few wet spots, which are indicated by spot symbols on the soil map.

Included with this soil in mapping are small areas of Friesland fine sandy loam, 1 to 6 percent slopes. Also included are some areas where the surface layer and subsoil are mostly loamy fine sand with a few thin strata of finer textured material and areas where the substratum is silt loam.

This soil is somewhat droughty during dry seasons. Runoff is slow. The erosion hazard is slight. Tilth is good.

This soil is well suited to cultivated crops. Most of the acreage is cropped to corn, small grain, or vegetable crops, such as peas and sweet corn. Capability IIIs–4; woodland group 1o1; wildlife group 4.

Sandy Land

Sandy land (Sd) consists of fill areas and cut or borrow areas, mainly within or near urban areas. In fill areas, a layer of fill material 1 to 5 feet thick has been deposited over a mineral or organic soil. In cut or borrow areas, the surface layer and subsoil have been removed, and the raw underlying material is exposed. The material is mainly sand that contains only a small amount of gravel or fine-textured material. Slopes are mainly 0 to 2 percent. Filled areas that have not been leveled are more sloping. Included in mapping are small areas where the surface material is loamy and small areas where it is gravelly.

Permeability is rapid. Available water capacity and fertility are low.

Limitations and hazards vary. They can be determined only by onsite investigation. Capability unit VIIIs–10; woodland group not classified; wildlife group. 8.

Saybrook Series

The Saybrook series consists of well-drained silty soils that formed in 26 to 36 inches of silty sediment and the underlying calcareous sandy loam glacial till, These soils occupy silt-covered till plains. Slopes are typically 2 to 8 percent but range to 20 percent. The native vegetation was grasses.

In a representative profile the surface layer is silt loam about 13 inches thick. The upper 10 inches is very dark brown, and the lower 3 inches is very dark grayish brown. The subsoil is about 25 inches thick. The upper 18 inches is dark yellowish-brown, firm silty clay loam; the next 4 inches is dark–brown, friable heavy silt loam; and the lower 3 inches is dark-brown, friable sandy loam. The substratum is yellowish-brown, slightly effervescent sandy loam.

Permeability is moderate. Available water capacity and fertility are high.

Most of the acreage is cultivated.

Representative profile of Saybrook silt loam, 2 to 6 percent slopes, eroded, in an uneroded area in a cornfield 138 feet north and 63 feet west of the southeast corner of SE¼ sec. 17, T. 13 N., R. 12 E.

Ap—0 to 10 inches, very dark brown (10YR 2/2) silt loam; moderate, fine, subangular blocky structure; friable;; common fine roots; neutral; abrupt, smooth boundary.

A3—10 to 13 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, medium, subangular blocky structure; friable; common fine roots; neutral; clear, wavy boundary.

B21t—13 to 31 inches, dark yellowish-brown (10YR 4/4) silty clay loam; moderate, fine and medium, subangular blocky structure; firm; few fine roots; common thin clay films on faces of peds; slightly acid; clear, wavy boundary.

B22t—31 to 35 inches, dark-brown (7.5YR 4/4) heavy silt loam; weak, medium, subangular blocky structure; friable; few fine roots; common thin clay films on faces of peds; slightly acid; clear, wavy boundary.

IIB3t—35 to 38 inches, dark-brown (7.5YR 4/4) sandy loam; weak, medium, subangular blocky structure; friable; few fine roots; thin clay bridges between mineral grains; about 10 percent gravel; slightly acid; clear, wavy boundary.

IIC—38 to 60 inches, yellowish-brown (10YR 5/4) sandy loam; massive; very friable; about 14 percent gravel; slight effervescence.

The solum typically ranges from 35 to 40 inches in thickness but in places ranges from 30 to 42 inches. Depth to the till ranges from 26 to 36 inches. The A horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2) in color and from 10 to 18 inches in thickness. The B horizon is dark-brown (7.5YR 4/4 or 10YR 4/3) to yellowish-brown (10YR 5/4) heavy silt loam and silty clay loam. The IIB horizon is dark-brown (7.5YR 4/4) or dark yellowish-brown (10YR 3/4–4/4) sandy loam, heavy sandy loam, sandy clay loam, or clay loam. The upper 20 inches of the B horizon is less than 15 percent fine sand or coarser material. Reaction is commonly medium acid or slightly acid, but ranges to mildly alkaline in the lower part.

The Saybrook soils in this survey area have more sand and less silt in the C horizon than is defined as the range for the series.

Saybrook soils occur with Plano, Ringwood, and Ripon soils. They formed in a thinner mantle of silt and have a thinner solum than Plano soils. They contain more silt and less sand in the upper 20 inches of the Bt horizon than Ringwood soils. Unlike that of Ripon soils, their solum is not underlain by bedrock.

Saybrook silt loam, 2 to 6 percent slopes, eroded (SeB2).—This soil is in irregularly shaped or long areas on rises on the till plain. It occurs with Plano and Ringwood soils. Areas are commonly 30 to 60 acres in size. This soil has the profile described as representative of the series, but in most places part of the surface layer has been removed by erosion.

Included with this soil in mapping are small areas of Plano silt loam, 2 to 6 percent slopes, and Ringwood silt loam, 1 to 6 percent slopes, eroded. Also included are a few areas where the subsoil extends to a depth of more than 42 inches, areas where bedrock is at a depth of 40 to 60 inches, areas where slopes are less than 2 percent, areas where the substratum is sand and gravel outwash, and a few small areas where the lower part of the subsoil is mottled.

In the more sloping areas, runoff is medium and the erosion hazard is moderate.

This soil is well suited to crops. Most of the acreage is cultivated. Corn and vegetable crops are commonly grown. Capability unit IIe–1; woodland group not classified; wildlife group 4.

Saybrook silt loam, 6 to 12 percent slopes, eroded (SeC2).—This soil is in long areas on rises and along ridges on the till plain. It occurs with Plano and Ringwood soils. Areas range up to 30 acres in size. This soil has a profile similar to the one described as representative of the series, but the surface layer is 9 to 12 inches thick, and the mantle of silt is about 30 inches thick.

Included with this soil in mapping are small areas of Plano silt loam, 6 to 12 percent slopes, eroded; and Ringwood silt loam, 6 to 12 percent slopes, eroded. Also included are a few small areas where the subsoil extends to a depth of more than 42 inches, areas where bedrock is at a depth of 40 to 60 inches, and areas where the surface layer is only 7 to 9 inches thick.

Runoff is medium. The erosion hazard is moderate.

This soil is cropped to corn, small grain, or hay. A few areas are pastured. Erosion is the main limitation. Capability unit IIIe–1; woodland group not classified; wildlife group 4.

Saybrook silt loam, 12 to 20 percent slopes, eroded (SeD2).—This soil is along ridges and on knobs on the till plain. Areas are typically 5 to 10 acres in size. They are commonly long, but a few very small areas are roughly circular. The surface layer is commonly 8 to 10 inches thick, the mantle of silt ranges from 26 to 30 inches in thickness, and the substratum is at a depth of 30 to 35 inches.

Included with this soil in mapping are small areas of Griswold silt loam, 12 to 20 percent slopes, eroded. Also included are a few areas where the surface layer is 5 to 7 inches thick, areas where bedrock is at a depth of 40 to 60 inches, areas where the subsoil extends to a depth of more than 42 inches, and areas where depth to the underlying till is more than 36 inches.

Runoff is rapid. The erosion hazard is severe. Erosion is the main limitation.

This soil is poorly suited to cultivated crops. Most of the acreage is cropped to legumes or used for pasture. Small areas, within or contiguous to less sloping areas, are cropped to corn or small grain. Capability unit IVe–1; woodland group not classified; wildlife group 4.

Seaton Series

The Seaton series consists of well-drained silty soils. These soils formed in thick deposits of silt that have a high content of coarse silt. They occur in valleys and on bluffs adjacent to the Wisconsin River. Slopes range from 0 to 20 percent. The native vegetation was mixed deciduous forest.

In a representative profile the surface layer is very dark grayish-brown silt loam about 3 inches thick. The subsurface layer is brown silt loam about 8 inches thick. The subsoil extends to a depth of more than 60 inches. The upper 37 inches is yellowish-brown silt loam, and the lower 12 inches is brown silt loam.

Permeability is moderate. Available water capacity and fertility are high.

Most of the acreage is suited to crops.

Representative profile of Seaton silt loam, 6 to 12 percent slopes, eroded, in an uneroded area 60 feet east and 50 feet north of the southwest corner of NE¼ sec. 21, T. 12 N., R. 8 E.

A1—0 to 3 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, fine, granular structure; very friable; many fine roots; neutral; abrupt, smooth boundary.

A2—3 to 11 inches, brown (10YR 5/3) silt loam; weak, thin, platy structure; very friable; many fine roots; few very fine tubular pores; neutral; abrupt, smooth boundary.

B1—11 to 16 inches, yellowish-brown (10YR 5/4) silt loam; weak, fine, subangular blocky structure; very friable; common fine roots; few silt coatings on faces

of peds; common very fine tubular pores; strongly acid; clear, wavy boundary.

B2t—16 to 36 inches, yellowish-brown (10YR 5/4) silt loam; moderate, fine, subangular blocky structure; friable; few fine roots; few silt coatings on faces of peds; common very fine tubular pores; few thin clay films on faces of peds common at a depth of 30 to 36 inches and many thin clay films in pores; strongly acid; clear, wavy boundary.

B31t—36 to 48 inches, yellowish-brown (10YR 5/4) silt loam; weak, medium and coarse, subangular blocky structure; friable; few fine roots; common silt coatings on faces of peds; few fine and many very fine tubular pores; few thin clay films on faces of peds and many thin clay films in pores; strongly acid; gradual, wavy boundary.

B32—48 to 60 inches or more, brown (10YR 5/3) silt loam; weak, coarse, subangular blocky structure; friable; few fine roots; common silt coatings on faces of peds; few fine and many very fine tubular pores; few thin clay films on faces of peds and in pores; medium acid.

The solum is typically more than 60 inches thick, but ranges from 42 to more than 72 inches. The A1 horizon ranges from very dark brown (10YR 2/2) to dark grayish brown (10YR 4/2) and is 2 to 5 inches thick. If it occurs, the Ap horizon is 6 to 9 inches thick and ranges from very dark grayish brown (10YR 3/2) to brown (10YR 5/3). The A2 horizon is dark grayish brown (10YR 4/2) to brown (10YR 5/3) and ranges from 2 to 10 inches in thickness. The B horizon ranges from brown (10YR 4/3) to yellowish brown (10YR 5/4) and is silt loam or heavy silt loam. It is high in content of coarse silt and very fine sand. Content of clay is 18 to 24 percent. Reaction is typically medium acid or strongly acid, but ranges to neutral in the lower part. The C horizon is silt loam.

Seaton soils are similar to St. Charles soils and occur with Mt. Carroll soils. Their A horizon is thinner and contains less organic matter than that of Mt. Carroll soils, and they do not have a C horizon of stratified silt and fine sand at a depth of 45 to 60 inches, which is typical of those soils. They formed in thick deposits of silt, whereas the lower part of the solum of St. Charles soils formed in sandy loam glacial till.

Seaton silt loam, 0 to 2 percent slopes (SfA).—This soil is in irregularly shaped areas on valley floors and in slight depressions in basins. Areas are commonly less than 40 acres in size. The surface layer is 8 or 9 inches thick, and the subsurface layer is 1 to 4 inches thick.

Included with this soil in mapping are a few areas of Mt. Carroll silt loam, benches, 0 to 2 percent slopes; and areas where the soil is saturated at a depth of about 3 to 5 feet during wet seasons. Also included are a few small areas where the surface layer is darker colored and areas where the subsoil is dominantly silty clay loam.

Runoff is slow. The erosion hazard is slight. Water is likely to pond on the surface during wet seasons and after heavy rains.

The soil has few limitations and is well suited to intensive cultivation. Most of the acreage is cropped to corn or vegetable crops. Capability unit I; woodland group 1o1; wildlife group 1.

Seaton silt loam, 2 to 6 percent slopes, eroded (SfB2).—This soil is in irregularly shaped or long areas on terraces in valleys and basins. Areas are commonly 40 to 80 acres in size. This soil has a profile similar to the one described as representative of the series, but in most areas tillage has mixed the subsurface layer with the original surface layer, and part of this has been lost through erosion. The present surface layer is only 7 to 9 inches thick.

Included with this soil in mapping are a few small areas of Seaton silt loam, 0 to 2 percent slopes; Mt. Carroll silt loam, benches, 2 to 6 percent slopes; St. Charles silt loam, 2 to 6 percent slopes, eroded; and some areas where this soil is saturated at a depth of about 3 to 5 feet during wet seasons. Also included are a few small areas where the surface layer is darker colored, areas where the subsoil is dominantly silty clay loam, and a few places where there is little or no erosion.

This soil is more susceptible to erosion where slopes are 4 to 6 percent. Runoff is medium. The erosion hazard is slight to moderate.

This soil is well suited to intensive cultivation if well managed. Most of the acreage is cultivated. Capability unit IIe–1; woodland group 1o1; wildlife group 1.

Seaton silt loam, 6 to 12 percent slopes, eroded (SfC2).—This soil is along valley walls and on rises and the crests of bluffs. It follows the slopes set by the drainage pattern. Areas are commonly 20 to 40 acres in size. This soil has the profile described as representative of the series, but the surface layer is thinner. In cultivated areas the present surface layer is a mixture of the remaining original material, the subsurface layer, and material from the upper part of the subsoil. The present surface layer is only 6 to 8 inches thick.

Included with this soil in mapping are small areas of Mt. Carroll silt loam, benches, 6 to 12 percent slopes, eroded, and St. Charles silt loam, 6 to 12 percent slopes, eroded. In many places, this soil is segmented by short drainageways. In a few small areas, the subsoil is dominantly silty clay loam. In some places, the silt loam substratum is underlain at a depth of about 50 to 60 inches by sandy loam till.

Runoff is rapid. The erosion hazard is moderate.

Most of the acreage is cultivated. Corn or legumes are commonly grown. Erosion is the major limitation. Some acreage is used as pasture or woodland. Capability unit IIIe–1; woodland group 1o1; wildlife group 1.

Seaton silt loam, 12 to 20 percent slopes, eroded (SfD2). This soil is in long and somewhat narrow areas along valley sides. It follows the slope set by the drainage pattern. Areas are commonly less than 40 acres in size. This soil has a profile similar to the one described as representative of the series, but the surface layer is thinner. In cultivated areas the present surface layer is a mixture of the remaining original material the subsurface layer, and material from the upper part of the subsoil.

Included with this soil in mapping are a few small areas of St. Charles silt loam, 12 to 20 percent slopes, eroded. Also included are areas where the subsoil is silty clay loam, areas where slopes are segmented by short drainageways, and many gullies, which are indicated by spot symbols on the soil map.

Runoff is very rapid. The erosion hazard is severe.

This soil is too steep and erodible to be well suited to cultivated crops. It is better suited to woodland or limited pasture than to other uses. Capability unit IVe–1; woodland group 1r2; wildlife group 1.

Sisson Series

The Sisson series consists of well-drained loamy soils. These soils formed in stratified deposits of silt, fine sand, and very fine sand containing thin layers or lenses of finer or coarser textured sediment. They are on terraces, lake plains, and outwash plains and along valley sides. Some areas are also on flood plains of major drainageways. Slopes are commonly 0 to 20 percent, but range to 30 percent. The native vegetation was deciduous forest.

In a representative profile the surface layer is fine sandy loam about 4 inches thick. The upper 3 inches is black, and the lower 1 inch is dark brown. The subsurface layer is brown fine sandy loam about 8 inches thick. The subsoil is about 22 inches thick. The upper 4 inches is dark yellowish-brown, friable very fine sandy loam; the next 3 inches is dark yellowish-brown, friable loam; the next 11 inches is dark-brown, friable heavy loam; and the lower 4 inches is strong-brown, friable fine sandy loam. The substratum is yellowish-brown, medium acid, stratified silt and very fine sand.

Permeability is moderate. Available water capacity and fertility are high.

Much of the acreage is cultivated. Some is in pasture or woodland.

Representative of Sisson fine sandy loam, 2 to 6 percent slopes, 230 feet north of county Highway P and 0.6 mile east of county highway SS in sec. 5, T. 12 N., R. 11 E.

A11—0 to 3 inches, black (10YR 2/1) fine sandy loam; weak, fine, subangular blocky structure; very friable; many fine roots; slightly acid; abrupt, wavy boundary.

A12—3 to 4 inches, dark-brown (10YR 3/3) fine sandy loam; weak, fine, subangular blocky structure; very friable; many fine roots; medium acid, wavy boundary.

A2—4 to 12 inches, brown (10YR 4/3) fine sandy loam; weak, medium, platy structure; very friable; common fine roots; strongly acid; clear wavy boundary.

B1—12 to 16 inches, dark yellowish-brown (10YR 4/4) very fine sandy loam; weak, fine, subangular blocky structure; friable; common fine roots; strongly acid; clear, wavy boundary.

B21t—16 to 19 inches, dark yellowish-brown (10YR 4/4) loam; moderate, fine, subangular blocky structure; friable; common fine roots; few thin clay films on faces of peds; strongly acid; clear, wavy boundary.

B22t—19 to 30 inches, dark-brown (7.5YR 4/4) heavy loam; moderate, medium, subangular blocky structure; friable; common fine roots; common thin clay films on faces of peds; strongly acid; clear, wavy boundary.

B3—30 to 34 inches, strong-brown (7.5YR 5/6) fine sandy loam; weak, coarse, subangular blocky structure; friable; common fine roots; few ¼-inch strata of fine sand; medium acid; clear, wavy boundary.

IIC—34 to 60 inches, yellowish-brown (10YR 5/4) stratified silt and very fine sand and some thin lenses of fine sand; massive; friable; few fine roots; medium acid.

The solum commonly ranges from 26 to 36 inches in thickness but in places ranges from 24 to 42 inches. It ranges from slightly acid to strongly acid in reaction. Depth to carbonates is more than 40 inches. The A1 horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2) in color and from 1 to 4 inches in thickness. If cultivated, this soil has an Ap horizon of very dark grayish-brown (10YR 3/2) to brown (10YR 4/3) fine sandy loam that is 6 to 9 inches thick. The thin A3 horizon does not occur in many places. The A2 horizon ranges from dark grayish brown (10YR 4/2) to pale brown (10YR 6/3) in color and from 2 to 8 inches in thickness. It is fine sandy loam or very fine sandy loam. The weighted texture of the B horizon is heavy loam or sandy clay loam. Strata of silt loam, silty clay loam, fine sandy loam, sandy loam, light loam, or sandy clay loam are in the B horizon in some places. A distinguishing feature of these soils is stratification of moderately fine-textured and medium-textured sediment in the B horizon, the C horizon, or both, above a depth of 40 inches.

The Sisson soils in this survey are more acid than is defined as the range for the series.

The well-drained Sisson soils are in a drainage sequence with the somewhat poorly drained Kibbie soils and the poorly drained Colwood soils. They also occur with Salter soils. All formed in stratified deposits of silt and sand. Sisson soils have more clay in the B horizon than Salter soils.

Sisson fine sandy loam, 0 to 2 percent slopes (SnA).—Irregularly shaped or long areas of this soil are on terraces, lake basins, flood plains, valley floors, and in depressions in uplands. The areas are commonly 10 to 30 acres in size. This soil has a few wet spots, which are indicated by spot symbols on the soil map. The surface layer is commonly very dark grayish brown and 8 or 9 inches thick, and the subsurface layer is 2 to 4 inches thick.

Included with this soil in mapping are small areas of Salter fine sandy loam, 0 to 2 percent slopes, and Seaton silt loam, 0 to 2 percent slopes. Also included are some spots where the lower part of the subsoil is seasonally saturated and some spots where the surface layer is silt loam or is thicker and darker colored.

Runoff is very slow. In some places, this soil receives runoff from adjacent uplands. The water is likely to pond for short periods.

This soil has few limitations and is well suited to intensive cultivation. Most of the acreage is cropped to corn. Capability unit I; woodland group 2o1; wildlife group 1.

Sisson fine sandy loam, 2 to 6 percent slopes (SnB).—Large, irregularly shaped or long areas of this soil are on terraces, lake basins, and flood plains and on slight rises on uplands. A few spots are eroded. This soil has the profile described as representative of the series. In cultivated areas the surface layer is very dark grayish brown or dark grayish brown and 8 or 9 inches thick, and the subsurface layer, if it occurs, is less than 4 inches thick.

Included with this soil in mapping are small areas of Salter fine sandy loam, 2 to 6 percent slopes; Grellton fine sandy loam, 1 to 6 percent slopes; and Sisson fine sandy loam, 0 to 2 percent slopes. Also included are some areas where the surface layer is silt loam or loam. areas where the subsoil is mostly heavy silt loam, and areas where loamy glacial till is at a depth of 40 to 60 inches.

Runoff is slow. The erosion hazard is slight. Tilth is good.

This soil is well suited to cultivated crops. The areas are cultivated or in woodland. Wooded areas have a thick undergrowth. Erosion is the main limitation. Capability unit IIe–1; woodland group 2o1; wildlife group 1.

Sisson fine sandy loam, 6 to 12 percent slopes, eroded (SnC2).—This soil is in long or irregularly shaped areas along valley sides and ridges or on rolling topography

on uplands. The areas range up to 60 acres in size. In tilled areas the surface layer is dark grayish brown, dark brown, or brown and about 6 or 7 inches thick.

Included with this soil in mapping are small areas of Grellton fine sandy loam, 6 to 12 percent slopes, eroded, and Salter fine sandy loam, 6 to 12 percent slopes, eroded. Also included are a few areas where the surface layer and subsoil have a high content of silt, areas where loamy glacial till is at a depth of about 40 to 60 inches, and areas where the surface layer has not been appreciably eroded.

This soil has poor stability and, once started, erosion proceeds very rapidly. Runoff is medium. The erosion hazard is moderate. Tilth is good.

This soil is suited to cultivated crops, but erosion is a serious limitation in places. The soil is used for crops, pasture, and woodland. It is well suited to trees. Capability unit IIIe-1; woodland group 2o1; wildlife group 1.

Sisson fine sandy loam, 12 to 20 percent slopes, eroded (SnD2)—Long areas of this soil are along ridges and on valley sides. The areas are commonly less than 40 acres in size. Gullies are common and are indicated by spot symbols on the soil map. Slopes are dissected by short drainageways. The surface layer is very dark brown or very dark grayish brown and 1 or 2 inches thick. The thickness of the surface layer and subsoil is commonly 25 to 30 inches.

Included with this soil in mapping are small areas of Salter fine sandy loam, 12 to 20 percent slopes, eroded, and Seaton silt loam, 12 to 20 percent slopes, eroded. Also included are a few areas where loamy glacial till is at a depth of about 40 to 60 inches and areas where the surface layer and upper part of the subsoil are high in content of fine sand.

This soil has poor stability, and erosion proceeds very rapidly. Runoff is rapid. The erosion hazard is severe.

This soil is poorly suited to cultivated crops but is well suited to trees. Most of the acreage is in woodland or pasture. Capability unit IVe-1; woodland group 2r2; wildlife group 1.

Sisson fine sandy loam, 20 to 30 percent slopes (SnE).—Small, long and narrow areas of this soil are along wooded ridges and valley sides. A few gullies have formed and are indicated by spot symbols on the soil map. The profile is similar to the one described as representative of this series, but the substratum is commonly at a depth of 24 to 30 inches.

Included with this soil in mapping are small areas of St. Charles silt loam, 20 to 30 percent slopes. Also included are some areas where slopes are more than 30 percent, areas where the subsoil is dominantly fine sandy loam and silt loam, and areas where loamy glacial till is at a depth of 40 to 60 inches.

Runoff is very rapid. The erosion hazard is very severe.

This soil is heavily wooded and has a thick understory of vegetation. Capability unit VIe-1; woodland group 2r2; wildlife group 1.

Sparta Series

The Sparta series consists of excessively drained sandy soils formed in deep deposits of fine and medium sand. These soils occur in valleys and on terraces on the outwash plain. There are a few blowouts, which are indicated by spot symbols on the soil maps. Slopes range from 1 to 6 percent. The native vegetation was mixed grasses.

In a representative profile the surface layer is loamy fine sand about 15 inches thick. The upper 11 inches is very dark brown, and the lower 4 inches is dark brown. The subsoil is dark-brown loamy fine sand about 19 inches thick. The substratum is brownish-yellow, medium acid, fine and medium sand.

Permeability is rapid. Available water capacity and fertility are low.

Much of the acreage is cultivated. Some is used as pasture. Some is planted to conifers.

Representative profile of Sparta loamy fine sand, 1 to 6 percent slopes, 660 feet west and 520 feet north of the southeast corner of NE¼ sec. 35, T. 11 N., R. 8 E.

Ap—0 to 11 inches, very dark brown (10YR 2/2) loamy fine sand; weak, medium, subangular blocky structure; very friable; many fine roots; medium acid; abrupt, smooth boundary.

A3—11 to 15 inches, dark-brown (7.5YR 3/2) loamy fine sand; weak, coarse, subangular blocky structure; very friable; common fine roots; medium acid; clear, wavy boundary.

B2—15 to 34 inches, dark-brown (7.5YR 4/4) loamy fine sand; weak, coarse, subangular blocky structure; very friable; few fine roots; medium acid; gradual, wavy boundary.

C—34 to 60 inches, brownish-yellow (10YR 6/6) medium and fine sand; single grained; loose; medium acid.

The solum ranges from 24 to 40 inches in thickness. Reaction ranges from medium acid to strongly acid. The A horizon ranges from 10 to 18 inches in thickness. The A1 horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2). The A3 horizon is dark-brown (7.5YR 3/2) (10YR 3/3), very dark grayish-brown (10YR 3/2), or dark grayish-brown (10YR 4/2) loamy sand or loamy fine sand. The B horizon is dark-brown (7.5YR 4/4), brown (7.5YR 5/4), dark yellowish-brown (10YR 4/4), or yellowish-brown (10YR 5/4–5/6) loamy fine sand, loamy sand, or fine and medium sand. Fine and medium sand are dominant throughout the solum.

Sparta soils are similar to Plainfield soils and Salter variant. Their A horizon is thicker and contains more organic matter than the Salter variant. They have a thicker dark-colored surface layer than Plainfield soils.

Sparta loamy fine sand, 1 to 6 percent slopes (SpB).—This soil is commonly in long areas on valley floors and terraces on the outwash plain. The areas are commonly 20 to 30 acres in size.

Included with this soil in mapping are some small areas of soils that have loamy material at a depth of about 40 to 60 inches. Also included are some small areas where the soil is saturated at a depth of about 40 to 60 inches during wet seasons and a few areas where the surface layer is loamy sand.

This soil is droughty and susceptible to blowing if the plant cover is removed. The hazard of water erosion is slight. Runoff is slow.

This soil is cropped to hay, small grain, or corn. Part of the acreage is in pasture. Part is planted to conifers. Growth of plants is limited by low available water

capacity and low fertility. Capability unit IVs–3; woodland group 3s1; wildlife group 3.

Troxel Series

The Troxel series consists of well drained and moderately well drained silty soils. These soils formed in silty, recent alluvium washed mainly from soils that formed in silt on adjoining uplands. They are on foot slopes and in concave areas. Slopes range from 0 to 3 percent.

In a representative profile the surface layer is about 31 inches thick. The upper 15 inches is very dark brown silt loam; the next 9 inches is very dark grayish-brown silt loam; and the lower 7 inches is dark-brown heavy silt loam. The subsoil extends to a depth of about 60 inches. The upper 23 inches is brown and dark yellowish-brown light silty clay loam, and the lower part is yellowish-brown silt loam.

In most places, these soils are saturated at a depth of 3 to more than 5 feet for significant periods during wet seasons. They are subject to occasional overwash from runoff. Permeability is moderate. Available water capacity is very high. Fertility is high.

Most of the acreage is in corn and vegetable crops. There are no serious limitations.

Representative profile of Troxel silt loam, 0 to 3 percent slopes, in a field of alfalfa 1,320 feet south and 294 feet east of the northwest corner of sec. 18, T. 10 N., R. 10 E.

Ap—0 to 9 inches, very dark brown (10YR 2/2) silt loam; weak, fine and medium, subangular blocky structure; friable, slightly sticky, slightly plastic; common fine roots; many fine and few medium tubular pores; slightly acid; abrupt, smooth boundary.

A12—9 to 15 inches, very dark brown (10 YR 2/2) silt loam; moderate, fine and medium, subangular blocky structure; friable, sticky, plastic; common fine roots; many fine and few medium and coarse tubular pores; slightly acid; clear, wavy boundary.

A13—15 to 24 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, thick, platy structure parting to moderate, fine, subangular blocky; friable, slightly sticky, plastic; common fine roots; many fine and medium and few coarse tubular pores; slightly acid; clear, wavy boundary.

A3—24 to 31 inches, dark-brown (10YR 3/3) heavy silt loam; very dark brown (10YR 2/2) along root channels; weak, thick, platy structure parting to moderate, fine, subangular blocky; friable, sticky, plastic; common fine roots; many fine and common medium tubular pores; slightly acid; abrupt, wavy boundary.

B21t—31 to 41 inches, brown (10YR 4/3) light silty clay loam, very dark brown (10YR 2/2) along root channels; moderate, fine and medium, subangular blocky structure; friable, sticky, plastic; few fine roots; common fine and few medium tubular pores; few thin clay films on peds and in pores; slightly acid; clear, wavy boundary.

B22t—41 to 54 inches, dark yellowish-brown (10YR 4/4) light silty clay loam; common, fine, distinct, strong-brown (7.5YR 5/6) mottles and common, medium, prominent, gray (5Y 5/1) mottles; weak, medium, subangular blocky structure; friable, sticky, plastic; few fine roots; common fine and few medium tubular pores; few thin clay films in pores; slightly acid; clear, wavy boundary.

B3—54 to 60 inches, yellowish-brown (10YR 5/4) silt loam; common, fine, distinct, strong-brown (7.5YR 5/6) mottles and many, medium, prominent, gray (5YR 5/1) mottles; weak, medium, subangular blocky structure; friable, sticky, plastic; few fine roots; many fine and common medium tubular pores; very few thin clay films in pores; slightly acid; clear, wavy boundary.

The solum ranges from about 50 to 70 inches in thickness and from medium acid to neutral in reaction. The A horizon is 24 to 40 inches thick and is black (10YR 2/1) to very dark grayish brown (10YR 3/2). The A3 horizon, if it occurs, is silt loam or heavy silt loam. The B2 horizon is silt loam or light silty clay loam and ranges from 15 to 30 inches in thickness.

Troxel soils occur with Joy and Plano soils and are similar to Otter soils. They have a thicker A horizon than Joy or Plano soils and are not so wet as Joy soils. They are better drained than the poorly drained Otter soils.

Troxel silt loam, 0 to 3 percent slopes (TsA).—This soil is in irregularly shaped or fan-shaped areas on foot slopes and in concave areas that receive runoff from adjoining uplands. A few areas are large, but most are less than 60 acres in size.

Included with this soil in mapping are a few areas of Joy silt loam, 0 to 4 percent slopes, and Plano silt loam, 0 to 2 percent slopes. Also included are a few small areas where an old, buried surface layer is at a depth of 30 to 60 inches, some small areas where the surface layer is more than 40 inches thick, and some small areas where the surface layer is thinly stratified with loamy sediment.

Runoff is slow. The erosion hazard is slight.

This soil is well suited to all crops generally grown in the survey area. Most of the acreage is cropped to corn or peas. Capability unit I; woodland group 2o1; wildlife group 4.

Tustin Series

The Tustin series consists of well-drained sandy soils. These soils formed in 20 to 40 inches of sandy sediment and the underlying reddish, calcareous silty and clayey sediments. They occur in glacial lake basins and on terraces adjacent to lake basins. Slopes range from 2 to 6 percent. The native vegetation was mixed forest cover of pine and deciduous trees.

In a representative profile the surface layer is very dark grayish-brown loamy fine sand 9 inches thick. The subsoil is about 34 inches thick. The upper 16 inches is dark yellowish-brown, very friable loamy fine sand; the next 5 inches is dark-brown, friable heavy sandy clay loam; the next 6 inches is dark reddish-brown, firm silty clay; and the lower 7 inches is reddish-brown, firm heavy silty clay loam. The substratum is brown, moderately alkaline silty clay loam.

Permeability is rapid in the upper sandy sediment and slow in the lower clayey sediment. Available water capacity and fertility are medium.

Most of the acreage is cultivated.

Representative profile of Tustin loamy fine sand, 2 to 6 percent slopes, in a cornfield 120 feet south and 600 feet west of the northwest corner of SW¼NW¼ sec. 1, T. 12 N., R. 8 E.

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) loamy fine sand; weak, medium, subangular blocky structure; very friable; many fine roots; medium acid; abrupt, smooth boundary.

B1—9 to 25 inches, dark yellowish-brown (10YR 4/4) loamy fine sand; weak, coarse, subangular blocky

structure; very friable; common fine roots; slightly acid; clear, smooth boundary.

IIB21t—25 to 30 inches, dark-brown (7.5YR 4/4) heavy sandy clay loam; moderate, medium, subangular blocky structure; friable; few fine roots; common thin clay films on faces of peds; about 2 percent gravel; slightly acid; clear, wavy boundary.

IIB22t—30 to 36 inches, dark reddish-brown (5YR 3/4) silty clay; strong, fine, angular blocky structure; firm; few fine roots; continuous, moderately thick clay films on faces of peds; slightly acid; clear, wavy boundary.

IIB23t—36 to 43 inches, reddish-brown (5YR 4/4) heavy silty clay loam; strong, fine, angular blocky structure; firm; few fine roots; continuous thin clay films on faces of peds; mildly alkaline; gradual, wavy boundary.

IIC—43 to 60 inches, brown (7.5YR 5/4) silty clay loam; moderate, thin, platy structure; friable; moderately alkaline; strong effervescence.

The solum ranges from 30 to 50 inches in thickness. Depth to the underlying clayey material ranges from 20 to 40 inches. Reaction in the clayey lower part of the solum ranges from slightly acid to mildly alkaline. The Ap horizon ranges from very dark grayish brown (10YR 3/2) to dark brown (10YR 4/3) in color and from 7 to 9 inches in thickness. In a few places there is an A1 horizon of very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2) that is less than 5 inches thick. The B1 horizon ranges from brown (10YR 4/3) to light yellowish brown (10YR 6/4) and is loamy sand, loamy fine sand, or fine sand. The IIB21t horizon is dark-brown (7.5YR 4/4) or dark yellowish-brown (10YR 3/4 to 4/4) heavy sandy clay loam, sandy clay loam, loam, or heavy sandy loam. It ranges from 2 to 6 inches in thickness. The IIB22t and IIB23t horizons are dark reddish-brown (5YR 3/3 to 3/4), reddish-brown (5YR 4/3 to 5/4), dark-brown (7.5YR 4/4), or brown (7.5YR 5/4) heavy silty clay loam or silty clay. The upper 20 inches of the Bt horizon is about 35 to 45 percent clay and less than 35 percent sand. The C horizon is silty clay loam, heavy silty clay loam, or silty clay.

The well-drained Tustin soils occur with the somewhat poorly drained Tustin variant. Their solum generally is thinner than that of the Tustin variant, and the upper part of the IIB horizon commonly contains more clay.

Tustin loamy fine sand, 2 to 6 percent slopes (TuB).—Long, narrow areas of this soil are on slight rises and terraces of glacial lake basins. The areas are commonly 20 to 30 acres in size.

Included with this soil in mapping are small areas of Tustin loamy fine sand, mottled subsoil variant, 0 to 4 percent slopes. Also included are a few nearly level areas, areas where the soil is more acid than typical, areas where the silty and clayey sediment is below a depth of 40 inches, areas where slopes are more than 6 percent, and areas where part of the surface layer has been lost through soil blowing.

This soil is droughty in the upper part and subject to blowing if the plant cover is removed. Runoff is slow. The hazard of water erosion is slight. Most of the nutrients and available water are in the underlying silty and clayey sediment.

This soil is better suited to deep-rooted plants than to shallow-rooted plants. Most of the acreage is cultivated. Corn, small grain, and hay are grown. Small areas are in pasture or woodland. Capability unit IIIe-4; woodland group 3o1; wildlife group 3.

Tustin Variant

The Tustin variant consists of somewhat poorly drained sandy soils. These soils formed in 20 to 39 inches of sandy sediment and the underlying reddish calcareous clayey sediment. They are in glacial lake basins and on terraces adjacent to lake basins or drainageways. Slopes range from 0 to 4 percent. The native vegetation was mixed deciduous forest.

In a representative profile the surface layer is very dark grayish-brown loamy fine sand about 8 inches thick. The subsoil extends to a depth of more than 60 inches. The upper 11 inches is dark yellowish-brown, very friable loamy sand; the next 8 inches is pale-brown, very friable sand; the next 3 inches is dark reddish-brown, friable sandy loam; the next 6 inches is dark reddish-brown, friable heavy sandy loam; the next 9 inches is reddish-brown, friable clay loam; the next 11 inches is brown, friable silty clay loam; the next 3 inches is brown, friable sandy clay loam; and the lower 1 inch is brown, firm silty clay.

These soils are saturated at a depth of about 1 to 3 feet for significant periods during wet seasons. Permeability is rapid in the upper sandy sediment and slow in the lower clayey sediment. Available water capacity and fertility are medium.

These soils are used mainly to grow crops of corn, oats, and hay. They are not suited to some species of plants because they are seasonally wet and seasonally droughty. Some areas are used as pasture or woodland.

Representative profile of Tustin loamy fine sand, mottled subsoil variant, 0 to 4 percent slopes, 225 feet west and 270 feet north of the southeast corner of SW¼SW¼ sec. 5, T. 13 N., R. 9 E.

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loamy fine sand; weak, coarse, subangular blocky structure; very friable; many fine roots; mildly alkaline; abrupt, smooth boundary.

B11—8 to 19 inches, dark yellowish-brown (10YR 4/4) loamy sand; few, fine, distinct, yellowish-red (5YR 4/6) mottles and common, medium, distinct, pinkish-gray (7.5YR 6/2) mottles; weak, coarse, subangular blocky structure; very friable; common fine roots; about 2 percent gravel; neutral; clear, wavy boundary.

B12—19 to 27 inches, pale-brown (10YR 6/3) sand; few, medium, prominent, strong-brown (7.5YR 5/6) and dark reddish-brown (5YR 3/4) mottles; single grained; very friable; common fine roots; about 1 percent gravel; neutral; clear, wavy boundary.

IIB21t—27 to 30 inches, dark reddish-brown (5YR 3/4) sandy loam; few fine, prominent, black (5YR 2/1) and pinkish-gray (5YR 6/2) mottles and few, medium, prominent, light-brown (7.5YR 6/3) mottles; weak, medium, subangular blocky structure; friable; few fine roots; many thin clay bridges between mineral grains; neutral; clear, wavy boundary.

IIB22t—30 to 36 inches, dark reddish-brown (5YR 3/4) heavy sandy loam; few and common, fine, prominent, pinkish-gray (5YR 6/2) and black (5YR 2/1) mottles; weak, medium, subangular blocky structure; friable; few fine roots; few thin clay films on faces of peds and many, moderately thick clay bridges between mineral grains; slightly acid; clear, wavy boundary.

IIB23t—36 to 45 inches, reddish-brown (5YR 4/4) clay loam; few, fine, prominent, black (5YR 2/1) and light olive-gray (5Y 6/2) mottles and common, fine, prominent, yellowish-red (5YR 5/8) mottles; weak, medium, subangular blocky structure; friable; few fines roots; about 2 percent gravel; common thin clay films on faces of peds and many moderately thick clay bridges between mineral grains; mildly alkaline; clear, wavy boundary.

IIB24t—45 to 56 inches, brown (7.5YR 5/4) heavy silty clay loam; common, fine, prominent, light olive-gray (5Y 6/2) mottles and many, fine, distinct, strong-brown (7.5YR 5/6) mottles; weak, very fine, angular blocky structure; friable; about 15 percent sand; many thin clay films on faces of peds; mildly alkaline; abrupt, wavy boundary.

IIB31—56 to 59 inches, brown (7.5YR 5/4) sandy clay loam; few, fine, prominent, black (5YR 2/1) mottles and common, fine, distinct and prominent, strong-brown (7.5YR 5/6) and light olive-gray (5Y 6/2) mottles; weak, fine, angular blocky and medium subangular blocky structure; friable; moderately alkaline; abrupt, wavy boundary.

IIB32—59 to 60 inches, brown (7.5YR 5/4) silty clay; common, fine, prominent, light olive-gray (5Y 6/2) mottles and few, fine, distinct and prominent, strong-brown (7.5YR 5/6) and black (5YR 2/1) mottles; weak, very fine, angular blocky structure; firm; about 15 percent sand; moderately alkaline; slight effervescence.

The solum ranges from 45 to 65 inches in thickness. The upper sandy sediment ranges from 20 to 39 inches in thickness. Reaction in the sandy upper part of the solum, below the influence of agricultural lime, ranges from neutral to medium acid. The clayey lower part of the solum ranges from slightly acid to mildly alkaline, but in many places, the lower part of the IIB horizon is moderately alkaline. The Ap horizon is very dark grayish brown (10YR 3/2) to brown (10YR 4/3) and is 6 to 9 inches thick. The B1 horizon is sand, loamy sand, or loamy fine sand 10 to 25 inches thick. It has mottles with chroma of 2 at a depth within 30 inches. The IIB21t and IIB22t horizons are dark reddish brown (5YR 3/4), reddish brown (5YR 4/3–5/4), or brown (7.5YR 4/4–5/4) and have few to many mottles with chroma of 1 or 2. The dominant texture is sandy loam or heavy sandy loam, but in some places the lower few inches is sandy clay loam. The weighted average clay content is about 18 to 24 percent. The thickness of the IIB21t and IIB22t horizons combined ranges from 6 to 15 inches. At a depth of less than 40 inches, the lower part of the IIB horizon has an estimated clay content ranging from 35 to 50 percent. It is dominantly heavy silty clay loam or silty clay but, in many places, has thin strata of sandy clay loam, clay loam, or silty clay loam. It is reddish brown (5YR 4/3–5/4) or brown (7.5YR 4/4–5/4), has few to many mottles in chroma of 1 or 2, and ranges from 10 to 30 inches in thickness. The IIC horizon is typically reddish-brown (5YR 5/3) silty clay or stratified silts and clays.

Tustin variant soils occur with the well-drained Tustin soils. Their solum is generally thicker than that of Tustin soils, and the upper part of the IIB horizon generally contains less clay. In addition, they are wetter than Tustin soils.

Tustin loamy fine sand, mottled subsoil variant, 0 to 4 percent slopes (TvA).—Irregularly shaped areas of this soil are on convex areas within lake basins. Long, narrow areas are on terraces adjacent to lake basins and drainageways. The areas are typically 10 to 25 acres in size.

Included with this soil in mapping are small areas where more clay is in the upper part of the subsoil. Also included are a few wet spots and sand spots, both of which are indicated by spot symbols on the soil map; a few small areas where the surface layer is fine sandy loam; and a few small, poorly drained areas.

Runoff is slow. There is little or no water erosion hazard. Wetness and seasonal droughtiness are the major limitations. If cultivated, this soil is subject to blowing during dry seasons.

If adequately drained, this soil is better suited to deep-rooted plants than to shallow-rooted plants because most of the available water and nutrients are in the middle or lower part of the subsoil. Most of the acreage is cropped to corn, oats, or hay. Some is used as pasture. Some is woodland. Capability unit IIIw–6; woodland group 3o1; wildlife group 5a.

Wacousta Series

The Wacousta series consists of nearly level, very poorly drained silty soils that are high in content of organic matter in the surface layer. These soils formed in deep silty sediment. They are in depressions in broad, swalelike areas of silty soils. The native vegetation was water-tolerant grasses.

In a representative profile the surface layer is black mucky silt loam about 17 inches thick. The substratum, just below the surface layer, is moderately alkaline silt loam. The upper 17 inches is olive gray, and the lower part is dark gray.

These soils are saturated at or near the surface throughout most of the year. They are subject to ponding in spring and after heavy rains. Permeability is slow. Available water capacity is very high, and fertility is high.

Most of the acreage is used as pasture or wildlife habitat.

Representative profile of Wacousta mucky silt loam (0 to 2 percent slopes), 660 feet south and 280 feet west of the northeast corner of SW¼SE¼ sec. 2, T. 10 N., R. 12 E.

Ap—0 to 9 inches, black (5YR 2/1) mucky silt loam; weak, medium, subangular blocky structure; friable; common fine roots; mildly alkaline; abrupt, smooth boundary.

A12—9 to 17 inches, black (5YR 2/1) mucky silt loam; common, fine, prominent, grayish-brown (10YR 5/2) mottles; weak, coarse, subangular blocky structure parting to moderate, fine, subangular blocky; friable; few fine roots; few medium tubular pores; mildly alkaline; clear, smooth boundary.

C1g—17 to 34 inches, olive-gray (5Y 5/2) silt loam; few, fine, faint, greenish-gray (5BG 5/1) mottles and few, medium, distinct, light olive-brown (2.5YR 5/4) mottles; massive; friable; few medium and coarse tubular pores; moderately alkaline; slight effervescence; clear, wavy boundary.

C2g—34 to 60 inches, dark-gray (5YR 4/1) silt loam; few, medium, prominent, olive-brown (2.5Y 4/4) mottles and few, fine, faint, gray (5Y 5/1) mottles adjacent to pores; massive; very friable; moderately alkaline; slight effervescence.

The solum ranges from 10 to 24 inches in thickness. Depth to carbonates ranges from 14 to 20 inches. The A horizon is 8 to 18 inches thick and is typically mucky silt loam, but in some places the lower part is silt loam. A Bg horizon occurs in some places and is silt loam that ranges from 1 to 6 inches in thickness.

The Wacousta soils in this survey area contain less clay in the solum than is defined as the range for the series.

Wacousta soils occupy slight depressions within areas of Ossian soils. They have more organic matter in the surface layer, have a thinner solum, and are wetter than those soils.

Wacousta mucky silt loam (0 to 2 percent slopes) (Wa).—Small areas of this soil are in swales within areas of Ossian soils. Some larger areas are in low basins that have very slow runoff.

Included with this soil in mapping are small, slightly convex areas of Ossian silt loam. Also included are small areas of soils that have thin layers of fine sand in the substratum and a few areas where the surface layer is not mucky.

This soil is very wet and difficult to drain. Even if the soil is drained, crops are drowned out in some years. Runoff is ponded for long periods in most areas.

Most of the acreage is used as pasture. A few drained areas are cropped to corn or peas. Capability unit IIw–1; woodland group 3w5; wildlife group 5b.

Wallkill Series

The Wallkill series consists of nearly level, very poorly drained silty soils. These soils formed in 24 to 40 inches of silty alluvium that was deposited over organic material. They occur along rivers that run through areas of organic soil and along the margins of mucky areas adjacent to mineral soils on uplands. Uncultivated areas are in water-tolerant grasses and shrubs.

In a representative profile the upper mineral sediment is silt loam about 26 inches thick. The upper 13 inches is very dark grayish brown, the next 7 inches is very dark gray, and the lower 6 inches is black. The lower organic material is black, slightly acid muck.

These soils are saturated at or near the surface throughout most of the year. They are subject to ponding in spring and after heavy rains. Permeability is moderate in the mineral sediment and moderately rapid in the underlying organic material. Available water capacity is very high. Fertility is high. Along streams, these soils are subject to frequent flooding. Along the margins of mucky areas adjacent to mineral soils or uplands, they are subject to frequent overflow from runoff.

Most of the acreage is pastured. If drained, these soils are used for corn and vegetable crops.

Representative profile of Wallkill silt loam (0 to 2 percent slopes), 528 feet east and 462 feet south of the northwest corner of SE¼NE¼ sec. 35, T. 13 N., R. 12 E.

A11—0 to 13 inches, very dark grayish-brown (10YR 3/2) silt loam; few, fine, prominent, dark-red (2.5YR 3/6) mottles and common, medium, faint, dark grayish-brown (10YR 4/2) mottles; weak, thin, platy structure; friable; common fine roots; few fine tubular pores; common, fine, distinct, black (5YR 2/1) stains; few worm casts; mildly alkaline; abrupt, smooth boundary.

A12—13 to 20 inches, very dark gray (10YR 3/1) silt loam; common, fine, prominent, dark-red (2.5YR 3/6) mottles and common, medium, distinct, grayish-brown (2.5Y 5/2) mottles; weak, thin, platy structure; very friable; few fine roots; common fine and few coarse tubular pores; common, fine, distinct, black (5YR 2/1) stains; few worm casts; neutral; abrupt, smooth boundary.

A13—20 to 26 inches, black (10YR 2/1) silt loam; few, fine, prominent, red (2.5YR 4/8) mottles and common, medium, distinct, dark grayish-brown (2.5Y 4/2) mottles; weak, thin, platy structure; friable; few fine roots; few fine and coarse tubular pores; few worm casts; few, small, irregular pockets of organic matter; neutral; abrupt, smooth boundary.

IIOab—26 to 60 inches, black (10YR 2/1) sapric material; about 20 percent fiber, 1 percent rubbed; massive; friable; primary herbaceous fibers; few worm casts in upper few inches; slightly acid (pH 6.5 in H_2O).

The upper mineral sediment ranges from 24 to 40 inches in thickness. Reaction ranges from slightly acid to mildly alkaline. The organic layer beneath the mineral soil is at least 20 inches thick. The A horizon is black (10YR 2/1) to very dark grayish-brown (10YR 3/2) loam, heavy silt loam, or silty clay loam. The weighted average clay content of the A horizon is 18 to 24 percent. The IIOab horizon is primarily herbaceous, but in some places it contains woody fragments. It is black, dark reddish brown, or very dark brown and is dominantly muck, but, in some places, this horizon contains thin layers of peat.

The Wallkill soils in this survey area have a lower sand content, a higher silt content, and darker colors in the A horizon than is defined as the range for the series.

Wallkill soils occur with Otter soils. Unlike those soils, they are underlain by organic material at a depth of 24 to 40 inches.

Wallkill silt loam (0 to 2 percent slopes) (Wb).—This soil occurs along rivers that run through areas of organic soil and along the margins of mucky areas adjacent to mineral soils on uplands. The areas along rivers are broad and long, and those along the margins of mucky areas are irregularly shaped or fan shaped. Most areas are less than 30 acres in size.

Included with this soil in mapping are small areas of varying textured loamy sediment overlying the organic material. Some small areas where the mineral sediments are less than 24 inches or more than 40 inches thick are also included.

Runoff is very slow to ponded. The erosion hazard is slight. Wetness, along with frequent flooding or overflow, are the major limitations.

Most of the acreage is used as pasture or wildlife habitat. Some drained areas are used for crops. Capability unit IIw–1; woodland group 4w5; wildlife group 5b.

Wasepi Series

The Wasepi series consists of somewhat poorly drained loamy soils underlain at a depth of 20 to 40 inches by stratified sand and some gravel. These soils occur on terraces on outwash plains, valley plains, and lake plains. Slopes range from 0 to 3 percent. The native vegetation was deciduous forest and some grasses.

In a representative profile the surface layer is very dark grayish-brown fine sandy loam about 9 inches thick. The subsoil is about 19 inches thick. The upper 6 inches is yellowish-brown, very friable sandy loam; the next 7 inches is dark yellowish-brown, friable heavy sandy loam; and the lower 6 inches is dark-brown, friable sandy clay loam. The substratum is pale-brown, slightly effervescent sand containing some gravel.

These soils are saturated at a depth of about 1 to 3 feet for significant periods during wet seasons. Permeability is moderately rapid. Available water capacity and fertility are low.

Wasepi soils are cropped mainly to corn, small grain, soybeans, or hay. Some areas are in pasture or woodland.

Representative profile of Wasepi fine sandy loam, 0 to 3 percent slopes, in a field of soybeans, 450 feet south and 320 feet west of the northeast corner of NW¼ sec. 30, T. 13 N., R. 10 E.

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) fine sandy loam; weak, coarse, subangular blocky structure; very friable; common fine roots; about 1 percent gravel; medium acid; abrupt, smooth boundary.

B1—9 to 15 inches, yellowish-brown (10YR 5/4) sandy loam; few, fine, distinct and prominent, grayish-brown (2.5Y 5/2) and yellowish-red (5YR 4/8) mottles; weak, coarse, subangular blocky structure; very friable; few fine roots; about 8 percent gravel; medium acid; clear, wavy boundary.

B21t—15 to 22 inches, dark yellowish-brown (10YR 4/4) heavy sandy loam; few, fine and medium, prominent and distinct, yellowish-red (5YR 4/8) and grayish-brown (2.5Y 5/2) mottles; weak, medium, subangular blocky structure; friable; few fine roots; about 10 percent gravel and 2 percent cobblestones; few thin clay films on faces of peds and common thin clay bridges between mineral grains; medium acid; clear, wavy boundary.

B22t—22 to 28 inches, dark-brown (7.5YR 4/4) sandy clay loam; many, medium, distinct and prominent, grayish-brown (2.5Y 5/2) and yellowish-red (5YR 5/8) mottles; moderate, medium, subangular blocky structure; friable; few fine roots; about 10 percent gravel and 2 percent cobblestones; few thin clay films on faces of peds and many, moderately thick clay bridges between mineral grains; medium acid; abrupt, wavy boundary.

IIC1—28 to 35 inches, pale-brown (10YR 6/3) sand; few, fine, prominent, strong-brown (7.5YR 5/8) mottles and common, coarse, prominent, dark reddish-brown (5YR 3/4) mottles; single grained; very friable; about 5 percent gravel; slightly acid; clear, wavy boundary.

IIC2—35 to 60 inches, pale-brown (10YR 6/3) sand; many, medium, prominent, strong-brown (7.5YR 5/6) mottles; single grained; loose; about 3 percent gravel; slight effervescence.

The solum ranges from 20 to 40 inches in thickness and from medium acid to neutral in reaction. In some places, it is as much as 25 percent gravel. The Ap horizon is very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2) and is 6 to 9 inches thick. The B2 horizon ranges from dark brown (10YR 4/3–7.5YR 4/4) to light yellowish brown (10YR 6/4), has few to many mottles in chromas of 1 or 2, and ranges from sandy loam to sandy clay loam. The total thickness of the B horizon that has sandy clay loam texture is less than 8 inches. The weighted average clay content of the B horizon is 12 to 18 percent. The IIC horizon is dominantly sand, but has some gravel, and in some places it is stratified sand and fine gravel.

The Wasepi soils in this survey area generally contain less gravel in the C horizon than is defined as the range for the series.

The somewhat poorly drained Wasepi soils occur with the well-drained Boyer and Oshtemo soils. They contain more organic matter in the A horizon than Boyer and Oshtemo soils. They have a thinner solum than Oshtemo soils.

Wasepi fine sandy loam, 0 to 3 percent slopes (WcA).—Small, irregularly shaped areas of this soil are on terraces on outwash plains, valley plains, and lake plains. Some larger, long areas are on terraces bordering depressions and along drainageways.

Included with this soil in mapping are small areas of Yahara fine sandy loam, 0 to 4 percent slopes, and Morocco loamy sand, 0 to 3 percent slopes. Also included are a few wet spots, sand spots, and small depressions, all of which are indicated by spot symbols on the soil map; some small areas where the surface layer is loamy sand, loam, or sandy loam; small areas where the surface layer is 10 to 12 inches thick; a few small areas where the substratum is coarse sand and gravel; and some small areas on flood plains where the surface soil and subsoil are high in content of silt.

This soil tends to be droughty during dry seasons. Runoff is slow. There is little or no erosion hazard. Wetness and low fertility are the major limitations.

If adequately drained, this soil is cropped to corn, small grain, soybeans, or hay. Undrained areas are used as pasture or woodland. Even in adequately drained areas this soil is poorly suited to crops. Capability unit IVw–5; woodland group 3o1; wildlife group 5a.

Winneshiek Series

The Winneshiek series consists of well-drained loamy soils underlain at a depth of 20 to 40 inches by limestone. These soils formed in sandy loam glacial till. They occur along ridges and on rises on the till plain. Slopes range from 2 to 12 percent. The native vegetation was prairie grasses and deciduous trees.

In a representative profile the surface layer is very dark grayish-brown fine sandy loam about 7 inches thick. The subsoil is about 26 inches thick. The upper 8 inches is dark-brown, friable heavy sandy loam; the next 13 inches is dark-brown, friable sandy clay loam; and the lower 5 inches is dark-brown, friable heavy sandy loam. The subsoil is underlain at a depth of about 33 inches by limestone.

Permeability is moderate. Available water capacity is low, and fertility is medium. Limestone at a depth of 20 to 40 inches restricts many uses of these soils.

Winneshiek soils are used mainly for crops or pasture. The underlying limestone bedrock is mined and crushed in some areas.

Representative profile of Winneshiek fine sandy loam, 2 to 6 percent slopes, 160 feet south and 520 feet west of the northeast corner of NW¼SE¼ sec. 7, T. 11 N., R. 11 E.

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) fine sandy loam; dark grayish brown (10YR 4/2) dry; weak, coarse, subangular blocky structure; very friable; many fine roots; slightly acid; abrupt, smooth boundary.

B21t—7 to 15 inches, dark-brown (7.5YR 4/4) heavy sandy loam; weak, medium, subangular blocky structure; friable; few fine roots; about 7 percent gravel; many thin clay bridges between mineral grains; slightly acid; clear, wavy boundary.

B22t—15 to 28 inches, dark-brown (7.5YR 4/4) sandy clay loam; moderate, medium, subangular blocky structure; friable; few fine roots; about 10 percent gravel; few thin clay films on faces of peds and many, moderately thick clay bridges between mineral grains; slightly acid; clear, wavy boundary.

B3t—28 to 33 inches, dark-brown (7.5YR 4/4) heavy sandy loam between angular pieces of limestone; weak, fine, subangular blocky structure; friable; few fine roots; about 2 percent gravel; about 70 percent angular pieces of limestone; many thin clay bridges between mineral grains; mildly alkaline; abrupt, wavy boundary.

IIR—33 inches, limestone.

Thickness of the solum and depth to bedrock typically range from 30 to 40 inches, but in places range from 20 to 40 inches. The solum is commonly slightly acid or medium acid, but ranges to mildly alkaline in the lower part. The A1 or Ap horizon is very dark gray (10YR 3/1), very dark brown (10YR 2/2), or very dark grayish brown (10YR 3/2) and is 6 to 9 inches thick. The Bt horizon is dark brown (7.5YR 4/4) or dark yellowish brown (10YR 3/4–4/4). It is dominantly heavy sandy loam or sandy clay loam.

The Winneshiek soils in this survey area contain less clay in the subsoil than is defined as the range for the series. In addition, they lack the thin layer of clay residuum weathered from limestone immediately above the bedrock.

Winneshiek soils occur with Griswold soils and are similar to Military soils. They have a thinner A horzon than Griswold soils and are shallower over bedrock. Unlike Military soils, which are underlain at a depth of less than 40 inches by sandstone, they are underlain by limestone. In addition they have more organic matter in the A horizon than Military soils.

Winneshiek fine sandy loam, 2 to 6 percent slopes (WnB).—This soil is in irregularly shaped areas on the crests of ridges and on slight rises on the till plain. Some areas range up to 200 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Griswold silt loam, 2 to 6 percent slopes, eroded. Also included are a few areas where the surface layer is silt loam, areas where the lower part of the subsoil is mottled, nearly level areas, areas where bedrock is at a depth of less than 20 or more than 40 inches, areas where a thin layer of raw till occurs immediately above the bedrock, some eroded areas, and a few limestone quarries, which are indicated by spot symbols on the soil map.

Runoff is slow. The erosion hazard is slight. Roots are limited by bedrock. Use of this soil as a septic tank filter field is hazardous.

This soil is well suited to the crops commonly grown in the survey area. Most of the acreage is cultivated. Capability unit IIe–2; woodland group 2o1; wildlife group 1.

Winneshiek fine sandy loam, 6 to 12 percent slopes, eroded (WnC2).—This soil is in irregularly shaped or long areas along ridges and on rises on the till plain. The areas are commonly 20 to 40 acres in size. This soil has a profile similar to the one described as representative of the series, but the thickness of the surface layer and subsoil combined is commonly 3 to 8 inches less. Some of the original surface layer has been lost through erosion, and the rest has mixed with material from the subsoil through tillage.

Included with this soil in mapping are small areas of Channahon silt loam, 6 to 12 percent slopes, eroded. Also included are a few areas where bedrock is at a depth of more than 40 inches, areas where the surface layer is silt loam, and a few bedrock outcrops, quarries, or gullies, all of which are indicated by spot symbols on the soil map.

Runoff is medium. The erosion hazard is moderate. Roots are restricted by bedrock.

Most of the acreage is used as pasture or for legumes. Capability unit IIIe–2; woodland group 2o1; wildlife group 1.

Wyocena Series

The Wyocena series consists of well-drained loamy and sandy soils. These soils formed mainly in calcareous glacial till of loamy sand texture. In some areas they formed in glacial till and in the underlying material weathered from fine-grained glauconitic sandstone. In these areas sandstone is at a depth of 40 to 60 inches. They occupy moraines, drumlins, and ridges on the till plains. Stones and boulders are on the surface in many areas. They are identified by spot symbols on the soil map. Slopes are commonly 2 to 20 percent, but range to 45 percent. The native vegetation was mixed deciduous forest.

In a representative profile the surface layer is very dark grayish-brown loamy sand about 8 inches thick. The subsoil is about 29 inches thick. The upper 8 inches is dark-brown, friable heavy sandy loam; the next 9 inches is dark-brown, friable sandy loam; and the lower 12 inches is yellowish-brown, very friable loamy sand. The substratum is light yellowish-brown, slightly effervescent loamy sand. The subsoil and substratum are as much as 8 percent gravel.

These soils are seasonally droughty. Available water capacity is low. Permeability is moderately rapid. Fertility is medium.

Much of the acreage is under cultivation. The more sloping areas are used for pasture or woodland.

Representative profile of Wyocena loamy sand, 2 to 6 percent slopes, 900 feet east and 700 feet north of the southwest corner of sec. 22, T. 12 N., R. 10 E.

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loamy sand; weak, coarse, subangular blocky structure; very friable; common fine roots; about 2 percent gravel; slightly acid; abrupt, smooth boundary.

B21t—8 to 16 inches, dark-brown (7.5YR 4/4) heavy sandy loam; weak, medium, subangular blocky structure; friable; few fine roots; few worm casts; about 8 percent gravel, about 2 percent cobblestones; many thin clay bridges between mineral grains; slightly acid; gradual, wavy boundary.

B22t—16 to 25 inches, dark-brown (7.5YR 4/4) sandy loam; weak, coarse, subangular blocky structure; friable; few fine roots; about 8 percent gravel, about 2 percent cobblestones; common thin clay bridges between mineral grains; neutral; clear, wavy boundary.

B3t—25 to 37 inches, yellowish-brown (10YR 5/6) loamy sand; weak, coarse, subangular blocky structure; very friable; few fine roots; about 4 percent gravel; few thin clay bridges between mineral grains; neutral; clear, wavy boundary.

C—37 to 60 inches, light yellowish-brown (10YR 6/4) loamy sand; massive; very friable; about 8 percent gravel, about 1 percent cobblestones; slight effervescence.

The solum typically ranges from 30 to 40 inches in thickness, but in places ranges from 24 to 40 inches. It is typically medium acid or slightly acid, but ranges to neutral in the lower part. It is as much as 15 percent gravel. The Ap horizon ranges from very dark grayish brown (10YR 3/2) to brown (10YR 4/3). Estimated organic-matter content is less than 1 percent. Where present, the A1 horizon is commonly very dark brown and is less than 5 inches thick. The Ap and A1 horizon is loamy sand or sandy loam. In most places tillage has mixed the A1, A2, and B1 horizons. In some places as much as 6 inches of sandy clay loam is in the B2 horizon. The upper 20 inches of the Bt horizon is about 12 to 18 percent clay. The B3 horizon is light sandy loam or loamy sand. The C horizon is loamy sand or heavy loamy sand and in places is more than 15 percent gravel. Stones are in many places.

Wyocena soils are near Okee soils and are similar to Lapeer soils. They have more clay and less sand in the upper part of the B horizon than Okee soils. They have less clay in the B horizon than Lapeer soils.

Wyocena loamy sand, 2 to 6 percent slopes (WoB).—This soil is on the sides of slight rises on the till plain. Areas are irregularly shaped or broad and long. They are commonly 40 to 80 acres in size, but range up to several hundred acres. This soil has the profile described as representative of the Wyocena series, but in some

places part of the original surface layer has been lost through soil blowing.

Included with this soil in mapping are small areas of Okee loamy fine sand, 2 to 6 percent slopes; Wyocena sandy loam, 2 to 6 percent slopes; and Boyer loamy sand, 2 to 6 percent slopes. Also included are a few small, nearly level areas; areas where the subsoil extends to a depth of more than 40 inches, and areas where sandstone bedrock is at a depth of 40 to 60 inches. In some places, the substratum is sandy loam glacial till.

This Wyocena soil is susceptible to blowing when the plant cover is removed. Runoff is slow. The hazard of water erosion is slight.

Most of the acreage is cultivated. Some is pastured or wooded. Growth of crops is limited by the low available water capacity. In places stones interfere with tillage. Capability unit IIIe–4; woodland group 3o1; wildlife group 3.

Wyocena loamy sand, 6 to 12 percent slopes, eroded (WoC2).—This soil is on the sides of rises and along ridges and drumlins on the till plain. Areas are commonly long and range from broad to narrow and from 30 to 60 acres in size. The surface layer is commonly dark grayish brown and is about 6 or 7 inches thick. The surface layer and subsoil combined are generally about 30 inches thick.

Included with this soil in mapping are small areas of Okee loamy fine sand, 6 to 12 percent slopes, and Wyocena sandy loam, 6 to 12 percent slopes, eroded. Also included are a few small areas where the subsoil extends to a depth of more than 40 inches; areas where the substratum is sandy loam glacial till, and areas where sandstone bedrock is at a depth of 40 to 60 inches.

This Wyocena soil is subject to blowing. Runoff is medium. The hazard of water erosion is moderate.

Much of the acreage is cultivated. Some is pastured or wooded. Growth of crops is limited by the low available water capacity. In places stones interfere with tillage. Capability unit IVe–4; woodland group 3o1; wildlife group 3.

Wyocena loamy sand, 12 to 20 percent slopes, eroded (WoD2).—This soil is in long, narrow areas along drumlins and ridges on the till plain. It has a few gullies, which are indicated by symbols on the soil map. The surface layer is commonly very dark brown and about 2 inches thick. The subsurface layer is brown or yellowish-brown loamy sand or light sandy loam about 4 or 5 inches thick. The lower part is dominantly light sandy loam. In a few tilled areas the surface layer is dark-brown loamy sand about 6 or 7 inches thick.

Included with this soil in mapping are small areas of Wyocena sandy loam, 12 to 20 percent slopes, eroded. Also included are a few small areas where the subsoil extends to a depth of more than 40 inches, areas where sandstone bedrock is at a depth of 40 to 60 inches, and areas where the substratum is light sandy loam glacial till.

This soil is very poorly suited to cultivated crops. rapid. The hazard of water erosion is moderate.
Most of the acreage is wooded or pastured. Growth of trees is limited by the low available water capacity. Capability unit VIe–4; woodland group 3r2; wildlife group 3.

Wyocena loamy sand, 20 to 45 percent slopes (WoE).—This soil is in long, narrow areas along ridges and drumlins on the till plain. It has a few gullies, which are indicated by symbols on the soil map. The surface layer is very dark brown loamy sand about 1 to 3 inches thick, the subsurface layer is brown loamy sand about 2 to 5 inches thick, and the subsoil is mainly light sandy loam. The surface layer and subsoil combined are generally 24 to 30 inches thick. Slopes commonly range from 20 to 30 percent.

Included with this soil in mapping are a few small areas where loamy sand extends to a depth more than 20 inches; areas where the substratum is sandy loam glacial till; areas where bedrock is at a depth of 40 to 60 inches; and areas where the substratum is at a depth of less than 24 inches or more than 40 inches. In a few places, the original surface layer has been lost through soil blowing and the present layer is sandy loam.

This Wyocena soil is subject to soil blowing. Runoff is rapid, and the hazard of water erosion is severe.

This soil is very poorly suited to cultivated crops. Most of the acreage is wooded. Some is pastured. Growth of trees is limited by the low available water capacity. Capability unit VIIe–4; woodland group 3r2; wildlife group 3.

Wyocena sandy loam, 2 to 6 percent slopes (WxB).—This soil is on the sides of slight rises on the till plain. Areas are commonly 40 to 80 acres in size but range up to several hundred acres. In some places, part of the original surface layer has been lost through erosion. The present surface layer is commonly very dark grayish brown and about 9 inches thick. In many places, the upper part of the subsoil, just below the surface layer, is brown sandy loam 1 to 4 inches thick. The lower part is dominantly heavy sandy loam.

Included with this soil in mapping are small areas of Wyocena loamy sand, 2 to 6 percent slopes; Wyocena fine sandy loam, sandstone substratum, 2 to 6 percent slopes; Lapeer fine sandy loam, 2 to 6 percent slopes; and Boyer fine sandy loam, 2 to 6 percent slopes. Also included are a few small, nearly level areas, areas where the substratum is at a depth of more than 40 inches; and areas where it is sandy loam glacial till. In some places, the surface layer is high in organic-matter content.

Runoff is slow. The erosion hazard is slight.

Most of the acreage is cultivated. In places stones interfere with tillage. Growth of crops is limited by the low available water capacity. Capability unit IIIe–4; woodland group 3o1; wildlife group 1.

Wyocena sandy loam, 6 to 12 percent slopes, eroded (WxC2).—This soil is on the sides of rises and along drumlins and ridges on the till plain. Areas are irregularly shaped or long and range from 30 to 60 acres in size. Tillage has mixed the surface layer with material from the subsoil. The present surface layer is commonly dark grayish brown or very dark grayish brown and about 6 or 7 inches thick. The surface layer and subsoil combined are generally about 30 inches thick. The subsoil is dominantly heavy sandy loam.

Included with this soil in mapping are small areas of Lapeer fine sandy loam, 6 to 12 percent slopes, eroded; Wyocena loamy sand, 6 to 12 percent slopes, eroded; and Wyocena fine sandy loam, sandstone substratum, 6 to 12 percent slopes, eroded. Also included are areas where the subsoil extends to a depth of more than 40 inches and areas where the substratum is sandy loam glacial till.

Runoff is medium. The erosion hazard is moderate.

Much of the acreage is cropped to corn, small grain, or legumes. Some is pastured or wooded. Growth of crops is limited by the low available water capacity. In some places, stones interfere with tillage. Capability unit IVe–4; woodland group 3o1; wildlife group 1.

Wyocena sandy loam, 12 to 20 percent slopes, eroded (WxD2).—This soil is in long, narrow areas along ridges and drumlins on the till plain. It commonly has a surface layer of very dark brown sandy loam about 2 inches thick and a subsurface layer of brown sandy loam about 3 inches thick. The upper part of the subsoil is brown or yellowish-brown sandy loam about 4 or 5 inches thick. The lower part is dominantly heavy sandy loam. The surface layer and subsoil combined are generally about 30 inches thick. A few gullies have formed. They are indicated by symbols on the soil map.

Included with this soil in mapping are small areas of Lapeer fine sandy loam, 12 to 20 percent slopes, eroded; Wyocena loamy sand, 12 to 20 percent slopes, eroded; and Wyocena fine sandy loam, sandstone substratum, 12 to 20 percent slopes, eroded. Also included are a few areas where the subsoil extends to a depth of more than 40 inches and areas where the substratum is sandy loam glacial till. In some of the more eroded spots, the subsoil is exposed at the surface.

Runoff is rapid. The erosion hazard is severe.

This soil is poorly suited to cultivated crops. Most of the acreage is pastured or wooded. Capability unit VIe–4; woodland group 3r2; wildlife group 1.

Wyocena fine sandy loam, sandstone substratum, 2 to 6 percent slopes (WyB).—This soil is on the crests of sandstone ridges and on the sides of slight rises on the till plain. Areas are irregularly shaped and are commonly 20 to 30 acres in size. The surface layer is commonly very dark grayish brown and about 7 to 9 inches thick. The upper part of the subsoil formed in glacial till. It extends to a depth of 30 inches or more, is dark-brown fine sandy loam, sandy loam, or heavy sandy loam, and is about 2 to 15 percent gravel. The lower part of the subsoil commonly formed in residuum from fine-grained glauconitic sandstone. It extends to a depth of about 40 to 50 inches and is fine sandy loam or loamy fine sand that has a reddish color. Content of gravel is low, if any, and the content of potash is estimated to be very high. A fine-grained, greenish or yellowish, glauconitic sandstone is just below the subsoil, at a depth of about 45 to 60 inches. It is weakly or very weakly cemented.

Included with this soil in mapping are small areas of Wyocena sandy loam, 2 to 6 percent slopes, and Military fine sandy loam, 2 to 6 percent slopes. Also included are a few small, nearly level areas where the sandstone is not glauconitic and the entire subsoil formed in glacial till; areas where the surface layer is loamy sand; and areas where sandstone bedrock is at a depth of less than 40 inches.

This Wyocena soil has more available water and nutrients than Wyocena sandy loam, 2 to 6 percent slopes. Runoff is slow. The erosion hazard is slight.

Most of the acreage is cultivated. Trees grow larger on this soil than on Wyocena sandy loam, 2 to 6 percent slopes. Capability unit IIIe–4; woodland group 3o1; wildlife group 1.

Wyocena fine sandy loam, sandstone substratum, 6 to 12 percent slopes, eroded (WyC2).—This soil is along sandstone ridges and on rises on the till plain. Areas are commonly long and range from 20 to 60 acres in size. The surface layer is commonly very dark grayish brown and about 4 to 7 inches thick. The upper part of the subsoil formed in glacial till. It extends to a depth of 30 inches or more, is dark-brown fine sandy loam, sandy loam, or heavy sandy loam, and is about 2 to 15 percent gravel. The lower part of the subsoil commonly formed in residuum from fine-grained glauconitic sandstone. It extends to a depth of about 40 to 50 inches and is fine sandy loam or loamy fine sand that has a reddish color. Content of gravel is low, if any, and the content of potash is estimated to be very high. A fine-grained, greenish or yellowish, glauconitic sandstone is just below the subsoil, at a depth of about 45 to 60 inches. It is weakly or very weakly cemented. In wooded areas the surface layer is black or very dark brown fine sandy loam about 1 or 2 inches thick, and the subsurface layer is brown fine sandy loam about 3 or 4 inches thick.

Included with this soil in mapping are small areas of Wyocena sandy loam, 6 to 12 percent slopes, eroded, and Military fine sandy loam, 6 to 12 percent slopes, eroded. Also included are a few areas where the sandstone is not glauconitic and the subsoil formed entirely in glacial till, areas where the surface layer is loamy sand, areas where most of the surface layer and subsoil formed in sandstone residuum, and areas where sandstone bedrock is at a depth of less than 40 inches.

This Wyocena soil has more available water and nutrients than Wyocena sandy loam, 6 to 12 percent slopes, eroded. Runoff is medium. The erosion hazard is moderate.

This soil is used for crops, woodland, or pasture. It is better suited to deep-rooted plants than to other plants because of the underlying glauconite substratum. Capability unit IVe–4; woodland group 3o1; wildlife group 1.

Wyocena fine sandy loam, sandstone substratum, 12 to 20 percent slopes, eroded (WyD2).—This soil is in long, narrow areas along sandstone ridges. It has a few gullies and outcrops of sandstone bedrock, all of which are identified by spot symbols on the soil map. The surface layer is black or very dark brown fine sandy loam about 1 inch thick and the subsurface layer is brown fine sandy loam about 3 to 5 inches thick. In a few places where this soil has been cultivated the surface layer is commonly very dark grayish brown and about 4 or 5 inches thick. The upper part of the subsoil formed in glacial till. It extends to a depth of 30 inches or more, is dark-brown fine sandy

loam, sandy loam, or heavy sandy loam, and is about 2 to 15 percent gravel. The lower part of the subsoil commonly formed in residuum from fine-grained glauconitic sandstone. It extends to a depth of about 40 to 50 inches and is fine sandy loam or loamy fine sand that has a reddish color. Content of gravel is low, if any, and the content of potash is estimated to be very high. A fine-grained, greenish or yellowish, glauconitic sandstone is just below the subsoil, at a depth of about 45 to 60 inches. It is weakly or very weakly cemented.

Included with this soil in mapping are small areas of Wyocena sandy loam, 12 to 20 percent slopes, eroded, and Military fine sandy loam, 12 to 20 percent slopes, eroded. Also included are some areas where the soil formed entirely in sandstone residuum, areas where the surface layer is loamy sand, and areas where the sandstone is not glauconitic and the subsoil formed entirely in glacial till.

This Wyocena soil has more available water and nutrients than Wyocena sandy loam, 12 to 20 percent slopes, eroded. Runoff is rapid. The erosion hazard is severe.

This soil is mainly forested. It is poorly suited to cultivated crops. Trees grow larger on this soil than on Wyocena sandy loam, 12 to 20 percent slopes, eroded. Capability unit VIe–4; woodland group 3r2; wildlife group 1.

Wyocena fine sandy loam, sandstone substratum, 20 to 45 percent slopes (WyE).—This soil is along sandstone ridges. It has a few gullies and outcrops of sandstone, all of which are identified by spot symbols on the soil map. Areas are long and range up to 100 acres in size. Slopes are commonly 30 to 40 percent. The surface layer is black or very dark brown fine sandy loam about 2 or 3 inches thick and the subsurface layer is brown fine sandy loam about 3 to 5 inches thick. The upper part of the subsoil formed in glacial till. It extends to a depth of 30 inches or more, is dark-brown fine sandy loam, sandy loam, or heavy sandy loam, and is about 2 to 15 percent gravel. The lower part of the subsoil commonly formed in residuum from fine-grained glauconitic sandstone. It extends to a depth of about 40 to 50 inches and is fine sandy loam or loamy fine sand that has a reddish color. Content of gravel is low, if any, and the content of potash is estimated to be very high. A fine-grained, greenish or yellowish, glauconitic sandstone is just below the subsoil, at a depth of about 45 to 60 inches. It is weakly or very weakly cemented.

Included with this soil in mapping are small areas of Wyocena loamy sand, 20 to 45 percent slopes. Also included are a few small areas where the sandstone is not glauconitic, areas where sandstone is within a depth of 40 inches, areas where the surface layer is loamy sand, and areas where the soil formed entirely in sandstone residuum.

This Wyocena soil has slightly more available water and nutrients than Wyocena loamy sand, 20 to 45 percent slopes. Runoff is very rapid. The erosion hazard is very severe where the plant cover has been removd.

This soil is forested. It is poorly suited to pasture or crops. Trees grow larger on this soil than on Wyocena loamy sand, 20 to 45 percent slopes. Capability unit VIIe–4; woodland group 3r2; wildlife group 1.

Yahara Series

The Yahara series consists of somewhat poorly drained loamy soils. These soils formed in stratified deposits of silt, fine sand, and very fine sand containing thin layers or lenses of finer or coarser textured sediment. They occupy terraces in depressions and valley floors along drainageways on lake plains and outwash plains. Some of these soils occur on flood plains of major drainageways. Slopes range from 0 to 4 percent. The native vegetation was mixed grasses and some deciduous trees.

In a representative profile the surface layer is fine sandy loam about 12 inches thick. The upper 8 inches is very dark brown, and the lower 4 inches is very dark grayish brown. The subsoil is about 14 inches thick. The upper 4 inches is brown, very friable loamy sand, and the lower 10 inches is dark-brown, friable fine sandy loam. The substratum is mixed gray and brown stratified silt and fine sand.

These soils are saturated at a depth of about 1 to 3 feet for significant periods during wet seasons. Permeability is moderate. Available water capacity and fertility are medium. In nearly level areas adjacent to major drainageways, the soils are subject to occasional flooding.

Most of the acreage is cultivated. Some is used as pasture.

Representative profile of Yahara fine sandy loam, 0 to 4 percent slopes, in a field of alfalfa 138 feet west and 660 feet north of the southeast corner of NW¼ sec. 3, T. 10 N., R. 11 E.

Ap—0 to 8 inches, very dark brown (10YR 2/2) fine sandy loam; moderate, fine, subangular blocky structure; very friable; many fine roots; neutral; abrupt, smooth boundary.

A12—8 to 12 inches, very dark grayish-brown (10YR 3/2) fine sandy loam; weak, medium, subangular blocky structure; friable; many fine roots; neutral; abrupt, smooth boundary.

B21—12 to 16 inches, brown (10YR 5/3) loamy sand; many, coarse, faint, grayish-brown (10YR 5/2) mottles and few, fine, prominent, strong-brown (7.5YR 5/6) mottles; weak, coarse, subangular blocky structure; very friable; common fine roots; neutral; clear, wavy boundary.

B22—16 to 26 inches, dark-brown (10YR 4/3) fine sandy loam; common, fine, faint, grayish-brown (10YR 5/2) mottles and many, medium, prominent, yellowish-red (5YR 4/8) mottles; weak, medium, subangular blocky structure; friable; common fine roots; medium acid; clear, wavy boundary.

Cg—26 to 60 inches, mixed gray (5Y 6/1) and brown (10YR 5/3) stratified silt and fine sand; common, medium, faint and prominent, grayish-brown (10YR 5/2), strong-brown (7.5YR 5/6), and yellowish-brown (10YR 5/6–5/8) mottles; massive; friable; few fine roots in upper 8 inches; medium acid to a depth of 39 inches and neutral below.

The solum ranges from 24 to 40 inches in thickness. It is typically medium acid or slightly acid in reaction and ranges from strongly acid to neutral. The A horizon is very dark brown (10YR 2/2), very dark grayish brown (10YR 3/2) or dark brown (10YR 3/3) and ranges from 9 to 14 inches in thickness. The B horizon is dark brown (10YR 4/3) to yellowish brown (10YR 5/4). Common or many mottles of 2 chroma or less are just below the A horizon. The weighted

texture of the B horizon is sandy loam, fine sandy loam, light loam or silt loam, and content of sand coarser than very fine is high. In some places the B horizon is heavy loam, silty clay loam, or sandy clay loam. The B2 horizon is 8 to 15 percent clay and 15 percent or more, by weight, of fine sand or coarser particles. A distinguishing feature of these soils is stratification of coarse-textured and medium-textured sediment in the B horizon, in the C horizon, or both, above a depth of 40 inches.

The Yahara soils in this survey area are generally more acid and contain less clay than is defined as the range for the series.

The somewhat poorly drained Yahara soils are in a drainage sequence with the well-drained Salter soils and the poorly drained Gilford soils. They also occur with Kibbie soils. They contain less clay and have a slightly thicker A horizon than Kibbie soils.

Yahara fine sandy loam, 0 to 4 percent slopes (YaA).—Areas of this soil are mostly long and somewhat narrow and occur on valley terraces along drainageways or on terraces bordering depressions. This soil typically occurs adjacent to Gilford soils. Some large, irregularly shaped areas are on flood plains and lake plains. Most areas are 20 to 30 acres in size.

Included with this soil in mapping are small areas of Gilford fine sandy loam, stratified substratum, 0 to 3 percent slopes; and Kibbie fine sandy loam, 0 to 4 percent slopes. Also included are some small spots of sand and wet spots, both of which are indicated by spot symbols on the soil map; small areas where the surface layer is loamy sand or loam; areas that have better drainage; small areas where the surface layer is less than 10 inches thick; areas where the soil is mostly sand and has only a few thin strata of loamy sediment; and a few areas where 5 to 15 inches of recent, alluvium is on the surface.

This soil tends to be droughty during dry seasons. Runoff is slow. There is little or no erosion hazard. Wetness is the major limitation. Draining this soil is difficult because the silt and sand tend to flow easily if saturated.

If adequately drained, and if fertility can be maintained, this soil is suited to crops. Most of the acreage is cultivated. Undrained areas are suited to pasture. Capability unit IIw–2; woodland group 1o1; wildlife group 5a.

Use and Management of the Soils

This section describes use and management of the soils of Columbia County for crops and pasture, woodland, wildlife, recreation, and engineering. It explains the system of capabality classification used by the Soil Conservation Service and gives predicted yields of the principal crops grown in the county. This section also groups the soils according to their suitability for woodland, wildlife, and recreational uses. It contains a shrub and vine planting guide and a tree planting and selection guide. Information in any one part of this survey commonly is useful as supplementary information in the other parts.

Management of Crops and Pasture

According to the Wisconsin Statistical Reporting Service, 69,700 acres of Columbia County in 1970 was in corn for grain, 22,500 acres in corn for silage, 46,900 acres in alfalfa hay, 27,500 acres in oats, 17,100 acres in sweet corn, 13,000 acres in peas, 5,700 acres in clover and timothy hay, 1,750 acres in soybeans, 1,200 acres in wheat, 700 acres in barley, 500 acres in potatoes, and 250 acres in tobacco. This represents 206,800 acres of crops, or almost half the county. Data from a 1970 conservation needs inventory indicate that about 36,500 acres in the county is pasture. In the paragraphs that follow, basic practices are suggested for managing the soils for the commonly grown crops and pasture mixtures.

The soils of Columbia County differ widely in their suitability for specific crops and differ widely in the management required. Maintaining tilth and fertility, liming, controlling erosion, providing drainage, and renovating are basic practices that are beneficial for practically all soils.

Tilth is maintained or improved by minimum tillage, growing grasses and legumes in the cropping system, and adding organic matter to the soil. Overtillage and heavy use of farm machinery compact the soil, especially a wet soil. Abundant organic matter can be supplied through crop residue and application of barnyard manure.

The soils in any given field can differ in acidity. Deep soils, such as St. Charles and Seaton soils, generally need the heaviest application of lime. Some of the very shallow soils, such as Rodman soils, may not need lime. Application of lime should be based on soil tests.

On all the soils, soil tests should be made to determine the kinds and amount of fertilizer. Generally, all crops grown in the county respond well to applications of commercial fertilizer. Organic soils, such as Houghton and Palms soils, have a low content of phosphorus and potassium. Regular applications of these elements are needed for good crop growth.

Large areas of Griswold, Lapeer, McHenry, and other soils in Columbia County are eroded as a result of runoff. Terracing, grassed waterways, stripcropping, contour tillage, plow planting, growing cover crops, and returning crop residue to the soil help to control water erosion. All are also effective in reducing runoff and increasing infiltration. A crop rotation that consists mainly of close-growing crops commonly controls erosion on the steeper soils. Contour stripcropping and terracing permit more intensive cropping on soils subject to water erosion. Grassed waterways are commonly used in areas that receive excess water after a rainfall. Diversions direct water away from critical areas and reduce the length of slopes. They are also effective in protecting low-lying soils from runoff from higher areas. Terraces are commonly used to protect sloping soils from water erosion. Dodge, Plano, and Saybrook soils, for example, are suitable for terracing. In general, soils can be cropped more intensively after terraces are installed than before.

Chelsea and Plainfield soils and some of the other sandy soils are susceptible to blowing. Wind stripcropping, shelterbelts, stubble mulching, crop residue on the surface, and cover crops are the common means of controlling erosion that results from soil blowing. Organic

soils, such as Adrian, also need protection from blowing if they are drained and cultivated.

Approximately 153,800 acres or about 31 percent of Columbia County consists of wet soils. These soils, for example, Atterberry, Ossian, and Houghton soils, are saturated for significant periods at a depth of less than 3 feet. They receive runoff from adjacent areas. Some have a moderately or moderately slowly permeable subsoil, some have a fluctuating high water table, and others are periodically flooded by stream overflow. In many areas these soils can be intensively cultivated if they are adequately drained or protected from overwash or flooding.

In some places diversions can be constructed to protect the soils from runoff from adjacent areas. In others, ditches are needed to convey water to a natural waterway. Shallow ditches can be used where deep ditches and tile drains are difficult to maintain, in Colwood and Granby soils, for example, both of which have an unstable subsoil or substratum. In loamy soils, such as Barry and Marcellon soils, tile drains and deep open ditches provide drainage. Otter and Wallkill soils are examples of soils that need protection from stream overflow.

Most supplies of forage in the county are obtained from hay grown in rotation with other crops. The hay is cut green and fed to livestock, or it is allowed to dry. Most upland pastures on well-drained soils in capability classes II, III, IV, and VI require periodic renovation to maintain fertility. A good seedbed should be prepared, and a suitable mixture of grasses and legumes seeded. Alfalfa and bromegrass or clover and timothy are examples of suitable mixtures for seeding. A companion crop of oats provides protective cover the first year and thereby helps in controlling erosion.

Large amounts of phosphorus and potassium are generally needed at the time of seeding. Nitrogen can be applied as a topdressing if the stand consists mostly of grasses. Permanent pasture should be topdressed yearly or renovated periodically to maintain good-quality forage. On steep or sandy soils, controlled grazing is needed to maintain good sod that helps control erosion.

A soil, such as alluvial land, loamy, wet, in capability class V, is subject to frequent flooding or ponding of long duration and has a high water table. Tillage is not practical, and renovation is not feasible. Such soils are generally kept in meadow and should be grazed only in dry seasons.

Pasture on soils of capability class VI is difficult to renovate. Soils of class VII are not suitable for renovation. Tillage is not feasible on these soils, and they are generally kept in natural vegetation. Controlling grazing and applying a commercial fertilizer help in controlling erosion and maintaining fertility.

Specialty crops.—The production of small fruits, vegetables, and other specialty crops is an important part of the economy. Nearly all of these crops are marketed for cash income, whereas field crops are produced chiefly for livestock feed.

Of the 72 counties in Wisconsin, Columbia County in 1970 ranked 1st in the production of sweet corn, 3rd in peas, 5th in tobacco, 11th in barley, 13th in wheat, 17th in potatoes, and 20th in soybeans. In addition, some acreage is cropped to strawberries, mint, cabbage, carrots, onions, cucumbers, snap beans, melons, and other specialty crops.

The soils of Columbia County vary in their suitability for these crops, and in many areas, special management is necessary to assure good growth of crops. Fertile soils that have high available water capacity, such as Joy, Plano, and Troxel soils, are especially well suited to sweet corn, tobacco, soybeans, cabbage, and snap beans. Soils that have good tilth but low to medium available water capacity are suited to such crops as strawberries, tomatoes, cucumbers, and melons. Irrigation and additions of nutrients are essential for good growth of crops on sandy soils. Organic soils, such as Adrian and Houghton soils, are commonly used to grow mint for oil, grass for sod, carrots, and onions. Large additions of phosphorus and potassium and controlled drainage are needed to assure good growth, alleviate wetness, and control subsidence and soil blowing.

Information about special management for specialty crops is available from the county agent or the local office of the Soil Conservation Service. In general, the management needed for high levels of production of sweet corn, peas, barley, wheat, and soybeans should be more intensive than that for the commonly grown crops.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are so used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for trees, or for engineering.

In the capability system, all kinds of soils are grouped at three levels; the capability class, the subclass, and the unit. These levels are described in the following paragraphs.

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, 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, require special conservation practices, or both.

Class IV soils have severe limitations that reduce the choice of plants, 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 largely to pasture or range, woodland, or wildlife.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.

Class VIII soils and landforms have limitations that preclude their use for commercial crop production and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in some parts of the United States, but not in Columbia County, shows that the chief limitation is climate that is too cold to too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, or range, woodland, wildlife, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similiar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–6 or IIIe–4. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages the capability units in Columbia County are described and use and management of the soils are suggested. The names of soil series represented in a capability unit are named in the description of the unit, but this does not mean that all soils of a given series are in the unit. To find the names of all the soils in any given capability unit, refer to the "Guide to Mapping Units" at the back of this survey.

Capability unit numbers generally are assigned locally, but are a part of a statewide system. All of the units in the system are not represented by the soils of Columbia County; therefore the numbers are not consecutive.

CAPABILITY UNIT I

This unit consists of deep, nearly level, well drained and moderately well drained soils of the Mt. Carroll, Plano, St. Charles, Seaton, Sisson, and Troxel series. These soils are silty or loamy throughout.

These soils are easy to manage and keep in good tilth. Permeabilty is moderate. Available water capacity is high or very high. Fertility is high. Runoff is slow to very slow, and the hazard of erosion is slight. Water is likely to pond for short periods after a heavy rainfall. Troxel soils are subject to occasional overflow of short duration.

Soils in this unit are well suited to crops, and they can also be used as pasture and for other less intensive purposes. The main crops are field corn, small grain, alfalfa for hay, sweet corn, peas, and beans.

CAPABILITY UNIT IIe–1

This unit consists of moderately deep and deep, gently sloping, well drained and moderately well drained soils of the Briggsville variant, Dodge, Friesland, Grellton, Griswold, Lapeer, McHenry, Mt. Carroll, Plano, Ringwood, St. Charles, Saybrook, Seaton, and Sisson series. These are loamy or silty soils that have a loamy subsoil.

Permeability is moderate to moderately slow. Available water capacity and fertility are medium to high. Runoff is slow to medium, and the hazard of erosion is slight to moderate. In places stones at the surface of Lapeer soils interfere with tillage. Controlling erosion is the main concern in management.

Soils in this unit are well suited to the crops commonly grown in the survey area, and they can also be used as pasture, woodland, or wildlife habitat. The main crops are field corn, oats, alfalfa, and canning crops, such as peas and sweet corn.

CAPABILITY IIe–2

This unit consists of moderately deep, gently sloping, well drained and moderately well drained soils of the Baraboo, Dresden, Knowles, Military, Ripon, and Winneshiek series. These are loamy and silty soils underlain by sand and gravel or bedrock at a depth of 20 to 40 inches.

These soils are easy to cultivate. Permeability is moderate. Available water capacity and fertility are medium. Runoff is slow to medium, and the hazard of erosion is slight to moderate. The root zone is somewhat restricted for deep-rooted plants. Controlling erosion and maintaining the available water capacity during dry periods are the main concerns in management.

Soils in this unit are well suited to corn, small grain, alfalfa for hay, and canning crops, such as peas or beans. They can also be used as pasture, wildlife habitat, or woodland.

CAPABILITY UNIT IIe-6

Briggsville loam, 2 to 8 percent slopes, is the only soil in this unit. It is deep and well drained to moderately well drained.

This soil is difficult to work if tillage extends into the more clayey subsoil. Permeability is moderately slow. Available water capacity and fertility are high. Runoff is slow, and the hazard of erosion is slight. Controlling erosion, maintaining tilth, and improving soil structure are the main concerns in management.

This soil is well suited to crops, and is also suited to pasture, woodland, and wildlife habitat. Corn, small grain, and forage crops are commonly grown. Growing legumes increases the pore space and permeability of the clayey subsoil.

CAPABILITY UNIT IIw-1

This unit consists of moderately deep and deep, nearly level, poorly drained and very poorly drained soils of the Barry, Colwood, Marshan, Ossian, Otter, Poygan, Wacousta, and Wallkill series. These are loamy and silty soils that have a loamy or clayey subsoil.

These soils dry out very slowly in spring and after rainy spells. Permeability is moderate in most of the soils, but is slow in Poygan soils. Available water capacity and fertility are high or very high in most of the soils, but are medium in Marshan soils. Runoff is very slow, and water is likely to pond during wet periods and after a heavy rainfall. The substratum of Marshan soils flows easily if saturated with water. Poygan soils are difficult to work if tillage extends into the clayey subsoil. In places stones at the surface of Barry soils interfere with tillage.

If adequately drained, soils in this unit are well suited to the crops commonly grown in the survey area. Corn, small grain, legumes and canning crops, such as sweet corn, are commonly grown. Small grain tends to lodge. Undrained areas are better used as permanent pasture, woodland, or wildlife habitat. Areas that cannot be drained are better suited to clover than to alfalfa.

CAPABILITY UNIT IIw-2

This unit consists of moderately deep and deep, nearly level and gently sloping, mainly somewhat poorly drained soils of the Atterberry, Joy, Kibbie, Marcellon, and Yahara series, Alluvial land, loamy, and the Grellton variant. All are loamy or silty throughout. Some areas of Alluvial land, loamy, are moderately well drained.

These soils dry out slowly in spring and after long rainy spells. Permeability is moderate. Available water capacity and fertility are medium to high. Runoff is slow to very slow. Alluvial land, loamy, is subject to flooding. Water is likely to pond for short periods after a heavy rainfall. In places stones at the surface of Marcellon soils interfere with tillage. The hazard of erosion is slight in gently sloping areas.

If drained, soils in this unit can be used for corn, small grain, bromegrass and alfalfa for hay, and canning crops, such as beans, and sweet corn. Permanent pasture, woodland, and wildlife habitat are suitable uses in undrained areas. In these areas clover can be substituted for alfalfa. Alluvial land, loamy, requires protection from flooding if it is cropped. Diversions can be constructed to protect these soils from overwash.

CAPABILITY UNIT IIw-8

Palms muck, the only soil in this unit, is a moderately deep to deep, nearly level, very poorly drained organic soil. Loam is at a depth of 16 to 51 inches. The muck is well decomposed.

This soil is very wet and needs drainage if it is to be used for cultivated crops. Permeability is moderately rapid in the organic material and moderately slow in the underlying loam. Available water capacity is very high, and fertility is low. Runoff is very slow. If drained and cultivated, this soil is subject to subsidence and blowing. Controlled drainage helps to prevent subsidence. The soil is deficient in phosphorus and potash. Along streams it needs protection from occasional flooding.

If drained, this soil is suited to corn, mint, sod for lawns, and truck crops, such as onions, carrots, and potatoes. Undrained areas are suited to pasture, woodland, or wildlife habitat.

CAPABILITY UNIT IIIe-1

This unit consists of moderately deep and deep, sloping, well drained and moderately well drained soils of the Dodge, Grellton, Griswold, Lapeer, McHenry, Mt. Carroll, Plano, Ringwood, St. Charles, Saybrook, Seaton, and Sisson series. These soils are loamy or silty throughout.

These soils must be properly managed to control erosion. Permeability is moderate. Available water capacity and fertility are medium to high. Runoff is medium, and the hazard of erosion is moderate. In places stones at the surface of Lapeer soils interfere with tillage.

Soils in this unit are used for corn, alfalfa, oats, and some canning crops, or they are in pasture or woodland. Contour stripcropping and minimum tillage reduce runoff and help to control loss of topsoil.

CAPABILITY UNIT IIIe-2

This unit consists of moderately deep, sloping, well drained and moderately well drained soils of the Baraboo, Dresden, Knowles, Military, Ripon, and Winneshiek series. These are loamy or silty soils underlain at a depth of 20 to 40 inches by sand and gravel or bedrock.

These soils are generally easy to cultivate, but in all but Dresden soils, bedrock outcrop restricts tillage. Permeability is moderate. Available water capacity and fertility are medium. Runoff is medium, and the hazard of erosion is moderate. These soils are restricted for deep-rooted plants. They must be well managed to control runoff and erosion and maintain available water.

Soils in this unit are suited to corn, small grain, and forage crops. Many of these soils are now used for pasture, woodland, or both. The wooded areas also serve as wildlife habitat.

CAPABLITY UNIT IIIe-3

This unit consists of shallow, gently sloping, well-drained soils of the Channahon, Lorenzo, and North-

field series. These are loamy soils underlain at a depth of less than 20 inches by sand and gravel or bedrock.

These soils are droughty in dry seasons, and have a restricted root zone. Permeability is moderate. Available water capacity is low. Fertility is medium. Runoff is slow, and the hazard of erosion is slight. Conserving moisture and controlling erosion are the main concerns in management.

Soils in this unit are used for corn, small grain, and alfalfa, but crops do not grow well during dry periods. Tillage is difficult in areas where bedrock crops out at the surface. Many of these soils are used as pasture, woodland, or wildlife habitat. Adding organic matter and maintaining good tilth are important in increasing infiltration and conserving moisture.

CAPABILITY UNIT IIIe-4

This unit consists of moderately deep and deep, gently sloping, well drained to moderately well drained soils of the Puchyan, Rotamer, Tustin, and Wyocena series. These are sandy and loamy soils that have a loamy or clayey subsoil.

These soils are droughty during dry seasons, and Puchyan, Tustin, and some of the Wyocena soils are subject to soil blowing. Permeability is moderate to rapid in all but Tustin soils, which have a slowly permeable substratum. Available water capacity is low to medium. Fertility is medium. Runoff is slow, and the hazard of water erosion is slight. Organic-matter content is generally low in the sandy soils. Seedling mortality is a hazard on Puchyan and Tustin soils. In places stones and gravel at or near the surface of Rotamer and Wyocena soils interfere with tillage. Conserving moisture and controlling erosion are the main concerns in management.

Soils in this unit are used for corn, small grain, and alfalfa, but crops do not grow well during dry periods. The soils are suited to pasture, woodland, or wildlife habitat. A permanent plant cover helps to control soil blowing on the sandy soils. Adding organic matter and maintaining good tilth help to conserve moisture.

CAPABILITY UNIT IIIe-7

This unit consists of moderately deep and deep, sloping, well-drained soils of the Boyer, Okee, Oshtemo, and Salter series. These are sandy and loamy soils that have a loamy subsoil.

These soils tend to be droughty, and the Boyer, Okee, and Oshtemo soils are subject to soil blowing unless protected by a plant cover. Permeability is moderate to rapid. Available water capacity and fertility are low to medium. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. Seedling mortality is a hazard on the sandy soils. The sandy soils generally require large additions of organic matter. Providing plant nutrients, conserving moisture, and controlling erosion are the main concerns in management.

Soils in this unit are poorly suited to crops. Crops do not grow well during dry periods. The soils are suited to pasture, woodland, or wildlife habitat. Conserving moisture and controlling soil blowing are essential.

CAPABILITY UNIT IIIw-6

Tustin loamy fine sand, mottled subsoil variant, 0 to 4 percent slopes, is the only soil in this unit. It is a deep, somewhat poorly drained sandy soil that has a clayey substratum.

This is a wet soil, but it is droughty during dry seasons and is subject to soil blowing unless protected by a plant cover. Permeability is rapid in the sandy upper layers and slow in the more clayey lower layers. Available water capacity and fertility are medium. Organic-matter content is low. Runoff is slow.

If drained, this soil is suited to corn, small grain, and hay. Seasonal wetness and droughtiness are limitations. Most of the acreage is permanent pasture, woodland, or wildlife habitat.

CAPABILITY UNIT IIIw-9

This unit consists of deep, nearly level, very poorly drained organic soils of the Boots and Houghton series. The organic material is well decomposed in the Houghton soils and partly decomposed in the Boots soils.

These soils are very wet and require drainage if they are to be used for cultivated crops. Permeability is moderately rapid. Available water capacity is very high. Fertility is low. Runoff is very slow. If drained and cultivated, the soils are subject to subsidence and blowing. Controlled drainage helps to prevent subsidence. Tillage must be done at the proper moisture content. The soils are deficient in phosphorus and potash. Along streams, they need protection from occasional flooding.

If properly drained, soils in this unit are suited to corn, mint, bluegrass for sod, and truck crops, such as onions, carrots, and potatoes. Undrained areas can be used as pasture, woodland, or wildlife habitat.

CAPABILITY UNIT IIIs-4

This unit consists of moderately deep and deep, nearly level and gently sloping, well drained to moderately well drained soils of the Boyer, Okee, Oshtemo, and Salter series and the Salter variant. These are sandy and loamy soils that have a loamy subsoil.

All of these soils tend to be droughty. Permeability is moderate to rapid. Available water capacity and fertility are low to medium in most of the soils. Fertility is high in the Salter dark surface variant. Runoff is slow to very slow, and the hazard of water erosion is slight. Boyer, Okee, and Oshtemo soils are subject to blowing unless they are protected by a plant cover. Seedling mortality is a hazard on the sandy soils, especially Okee soils. The sandy soils generally require large additions of organic matter. Providing plant nutrients, conserving moisture, and controlling soil blowing are the main concerns in management.

Soils in this unit are suited to corn, small grain, and forage crops, but these crops do not grow well during dry seasons. The soils are also suited to pasture, woodland, and wildlife habitat. Many areas are irrigated and used for cucumbers, melons, strawberries, and tomatoes, but acreages are generally small. All the soils are well suited to pine trees in plantations or windbreaks. Trees help control soil blowing.

CAPABILITY UNIT IVe-1

This unit consists of moderately deep and deep, moderately steep, well drained and moderately well drained soils of the Dodge, Griswold, Lapeer, McHenry, Mt. Carroll, St. Charles, Saybrook, Seaton, and Sisson series. These soils are loamy or silty throughout.

Permeability is moderate. Available water capacity and fertility are medium to high. Runoff is rapid, and the hazard of erosion is severe. In places stones at the surface of Lapeer soils interfere with tillage. Controlling erosion and maintaining tilth are difficult in cultivated areas.

Soils in this unit are cultivated in some places, but most are in pasture or woodland. They are too steep and erodible to be cropped intensively. Pastures require renovation.

CAPABILITY UNIT IVe-2

This unit consists of moderately deep, moderately steep, well drained and moderately well drained soils of the Baraboo, Dresden, Knowles, and Military series. These are loamy or silty soils underlain at a depth of 20 to 40 inches by sand and gravel or bedrock.

These soils are generally easy to cultivate, but in all but Dresden soils bedrock outcrop restricts tillage. Permeability is moderate. Available water capacity and fertility are medium. Runoff is rapid, and the hazard of erosion is severe. The root zone is restricted for deep-rooted plants. Conserving moisture, maintaining good tilth, and controlling erosion are the main concerns in management.

Soils in this unit are mostly in woodland or pasture. A permanent plant cover is needed to control runoff and erosion.

CAPABILITY UNIT IVe-3

This unit consists of shallow, sloping, well-drained soils of the Channahon, Lorenzo, and Northfield series. These are loamy soils underlain at a depth of less than 20 inches by sand and gravel or bedrock.

These soils are droughty during dry seasons and have a restricted root zone. Permeability is moderate. Available water capacity is low, and fertility is medium. Runoff is medium, and the hazard of erosion is moderate. Tillage is difficult where bedrock crops out at the surface. Controlling erosion and conserving moisture are difficult in cultivated areas.

Soils in this unit are mainly in pasture or woodland. They are too droughty during dry periods for good crop growth.

CAPABILITY UNIT IVe-4

This unit consists of moderately deep and deep, sloping, well drained to moderately well drained soils of the Puchyan, Rotamer, and Wyocena series. These are sandy and loamy soils that have a loamy subsoil.

These soils are droughty during dry seasons, and Puchyan soils and some of the Wyocena soils are subject to blowing. Permeability is moderate to rapid. Available water capacity is low to medium, and fertility is medium. Runoff is medium, and the hazard of water erosion is slight to moderate. Organic matter content is generally low in the sandy soils. Seedling mortality is a hazard on Puchyan soils. In places stones and gravel at or near the surface of Rotamer and Wyocena soils interfere with tillage. Good management is needed to control erosion and conserve moisture in cultivated areas.

Many of the soils in this unit are in permanent pasture or woodland. If these soils are used for permanent pasture, controlled grazing and pasture renovation periodically maintain a desirable cover of plants.

CAPABILITY UNIT IVe-7

This unit consists of moderately deep and deep, moderately steep and steep, well-drained soils of the Boyer, Oshtemo, and Salter series. These are sandy and loamy soils that have a loamy subsoil.

These soils tend to be droughty, and the Boyer and Oshtemo soils are subject to blowing unless protected by a plant cover. Permeability is moderate to moderately rapid. Available water capacity and fertility are low to medium. Runoff is medium to rapid, and the hazard of water erosion is severe. Seedling mortality is a hazard on the sandy soils. The sandy soils generally require large additions of organic matter. Careful management is needed to conserve moisture and control erosion in cultivated areas.

Soils in this unit are used mainly as pasture, woodland, or wildlife habitat. Limitations are severe for row crops. A permanent plant cover helps to control soil blowing.

CAPABILITY UNIT IVw-3

Gilford fine sandy loam, stratified substratum, 0 to 3 percent slopes, is the only soil in this unit. It is deep and poorly drained.

This soil dries out slowly in spring and after rainy spells. Permeability is moderate. Available water capacity and fertility are medium. Runoff is very slow. In places protection for overwash is needed.

If drained, this soil is suited to corn, small grain, and alfalfa for hay. Small grain tends to lodge. Undrained areas are better suited to clover than to alfalfa. These undrained areas are also suitable as permanent pasture, woodland, or wildlife habitat. Maintaining or improving fertility is the chief management need.

CAPABILITY UNIT IVw-5

This unit consists of moderately deep and deep, nearly level, somewhat poorly drained to very poorly drained soils of the Granby, Morocco, and Wasepi series and Alluvial land, sandy, and Alluvial land, sandy, wet. These are sandy and loamy soils that have a sandy substratum. Some areas of Alluvial land, sandy, are moderately well drained.

These soils are droughty during dry seasons and subject to blowing unless protected by a plant cover. They should also be protected from flooding or overwash. Permeability is moderately rapid to rapid. Available water capacity and fertility are low. Runoff is slow to very slow. Organic-matter content is low in Morocco and Wasepi soils and Alluvial land, sandy. In dry seasons Morocco and Wasepi soils and Alluvial land, sandy, are droughty and subject to blowing. The sandy substratum tends to flow easily if saturated, and con-

structuring and maintaining open-ditch drains are difficult.

Soils in this unit are mostly undrained and are used as permanent pasture, woodland, or wildlife habitat. They are poorly suited to crops. Alleviating wetness and maintaining or improving fertility are essential if these soils are to be used for crops.

CAPABILITY UNIT IVw-7

Adrian muck, the only soil in this unit, is a moderately deep to deep, nearly level very poorly drained organic soil. Sand is at a depth of 16 to 51 inches. The muck is well decomposed.

This soil is very wet and requires drainage if it is to be used for cultivated crops. Permeability is moderately rapid in the organic material and rapid in the underlying sand. Available water capacity is high, and fertility is low. Runoff is very slow. If drained and cultivated, the soil is subject to subsidence and blowing. Controlled drainage helps to prevent subsidence. Tillage must be done at the proper moisture content. This soil is deficient in phosphorus and potash. Along streams it needs to be protected from occasional flooding. The underlying sand flows easily if saturated.

Drained areas of this soil are suited to corn, mint, sod for lawns, and truck crops, such as onions, carrots, and potatoes. Addition of some nutrients is necessary for good crop growth. Undrained areas are in native pasture or woodland or are used as wildlife habitat.

CAPABILITY UNIT IVs-3

This unit consists of deep, nearly level and gently sloping, excessively drained soils of the Chelsea, Plainfield, and Sparta series. These are sandy soils that have a sandy subsoil.

These soils are droughty and subject to blowing unless protected by a plant cover. Permeability is rapid. Available water capacity and fertility are low. Runoff is slow or very slow, and the hazard of water erosion is slight. Organic-matter content is low in Chelsea and Plainfield soils. Droughtiness makes seedling mortality a hazard. The soils are very severely limited for crops.

Soils in this unit are poorly suited to crops. They are used mainly as limited pasture, woodland, or wildlife habitat. They have good potential for growing crops under irrigation. Many pine tree plantations and windbreaks are established on these soils.

CAPABILITY UNIT Vw-14

Only Alluvial land, loamy, wet, is in this unit. It is deep, nearly level, and poorly drained to very poorly drained and is loamy throughout.

Drainage is needed to improve plant growth. Protection from flooding is also needed. Permeability is moderate. Available water capacity and fertility are high. Runoff is very slow, and water ponds for long periods.

Soils in this unit are poorly suited to crops. They are mostly in woodland or permanent pasture or serve as wildlife habitat.

CAPABILITY UNIT VIe-1

This unit consists of moderately deep and deep, steep, well drained and moderately well drained soils of the Lapeer, St. Charles, and Sisson series. These soils are loamy throughout.

Permeability is moderate. Available water capacity and fertility are medium to high. Runoff is very rapid, and the hazard of erosion is very severe.

Soils in this unit are generally too steep and erodible to be used for cultivated crops. They are suited to woodland, wildlife habitat, or pasture. Many of the wooded areas are also used for pasture.

CAPABILITY UNIT VIe-2

Baraboo silt loam, 20 to 30 percent slopes, is the only soil in this unit. It is loamy and well drained to moderately well drained and is underlain at a depth of 20 to 40 inches by quartzite bedrock.

This soil is too steep and erodible to be used for crops. Permeability is moderate. Available water capacity and fertility are medium. Runoff is very rapid, and the hazard of erosion is very severe. The root zone is restricted for deep-rooted plants.

The entire acreage is in woodland and serves as good wildlife habitat.

CAPABILITY UNIT VIe-3

Lorenzo loam, 12 to 20 percent slopes, eroded, is the only soil in this unit. It is shallow and well drained and is less than 20 inches deep over sand and gravel.

This soil is droughty during dry seasons. Permeability is moderate. Available water capacity is low, and fertility is medium. Runoff is rapid, and the hazard of erosion is severe. The root zone is restricted by the underlying sand and gravel.

This soil is generally too steep, erodible, and droughty to be used for crops. It is mainly in pasture or woodland.

CAPABILITY UNIT VIe-4

This unit consists of moderately deep and deep, moderately steep, well-drained soils of the Rotamer and Wyocena series. These are sandy and loamy soils that have a loamy subsoil.

These soils are droughty during dry seasons. In some areas Wyocena soils are subject to blowing. Permeability is moderate to moderately rapid. Available water capacity is low to medium, and fertility is medium. Runoff is rapid, and the hazard of water erosion is moderate to severe. In places stone or gravel are at the surface. Controlling erosion is difficult in cultivated areas.

Soils in this unit are too steep, droughty, and erodible for growing crops. They are mainly in permanent pasture and woodland.

CAPABILITY UNIT VIs-3

This unit consists of deep, sloping, excessively drained soils of the Boone, Chelsea, and Plainfield series. These are sandy soils that have a sandy subsoil.

These soils are droughty and subject to soil blowing. Permeability is rapid. Available water capacity, organic-matter content, and fertility are low. Runoff is medium, and the hazard of water erosion is slight. Droughtiness makes seedling mortality a hazard.

Soils in this unit are mainly used as woodland, wildlife habitat, or limited pasture. They are well suited

to pine tree plantations. Growing crops on these soils is very difficult.

CAPABILITY UNIT VIs–5

This unit consists of very shallow, gently sloping to moderately steep, excessively drained soils of the Rodman series. These are gravelly soils less than 10 inches deep over gravel and sand.

These soils are very droughty. Permeability is very rapid. Available water capacity is very low, and fertility is low. The root zone is severely restricted. Tillage is difficult because gravel is at or near the surface.

Soils in this unit are mainly in permanent pasture. They are also suited to woodland and wildlife habitat. They are too shallow, droughty, and gravelly for cultivated crops.

CAPABILITY UNIT VIIe–3

This unit consists of shallow, moderately steep and steep, well-drained soils of the Channahon and Northfield series. These are loamy soils less than 20 inches deep over bedrock.

These soils are droughty during dry seasons. Permeability is moderate. Available water capacity is low, and fertility is medium. The root zone is limited, and outcrops of bedrock are common.

Soils in this unit are used as woodland and wildlife habitat. They are too steep for safe cultivation.

CAPABILITY UNIT VIIe–4

This unit consists of moderately deep and deep and very steep, well-drained soils of the Rotamer and Wyocena series. These are sandy and loamy soils that have a loamy subsoil.

These soils are droughty during dry seasons. In some areas the Wyocena soils are subject to blowing. Permeability is moderate to moderately rapid. Available water capacity is low to medium, and fertility is medium. Runoff is rapid to very rapid, and the hazard of water erosion is severe to very severe. In places stones or gravel are at the surface.

Soils in this unit are used as woodland and wildlife habitat. They are too steep, droughty, and erodible for growing cultivated crops.

CAPABILITY UNIT VIIs–3

This unit consists of deep, moderately steep to steep, excessively drained soils of the Plainfield series. These are sandy soils that have a sandy subsoil.

These soils are droughty and subject to soil blowing. Permeability is rapid. Available water capacity and fertility are low. Runoff is medium, and the hazard of water erosion is moderate. Droughtiness makes seedling mortality a hazard.

Soils in this unit are used as woodland and wildlife habitat. They are too steep and droughty to be suited to crops. A permanent plant cover is needed to control soil blowing.

CAPABILITY UNIT VIIs–5

Rodman gravelly loam, 20 to 45 percent slopes, is the only soil in this unit. It is excessively drained and is less than 10 inches deep over gravel and sand.

This soil is very droughty. Permeability is very rapid. Available water capacity is very low, and fertility is low. Runoff is very rapid, and the hazard of erosion is very severe. The root zone is severely restricted.

This soil is mainly used as woodland or wildlife habitat.

CAPABILITY UNIT VIIs–9

This unit consists of deep, gently sloping to very steep, excessively drained soils of the Boone and Plainfield series. These soils are sandy throughout.

These soils are droughty and subject to blowing. Blowouts are common on Plainfield soils. Permeability is rapid in all the soils. Available water capacity, organic-matter content, and fertility are low. Runoff is slow or medium, and the hazard of water erosion is slight or moderate.

Soils in this unit are very poorly suited to crops. They are mainly used as woodland or wildlife habitat. The vegetation is a sparse growth of oak trees and a ground cover of grasses. Permanent plant cover is needed to control soil blowing but establishing a plant cover is difficult. Planting pine trees helps to stabilize the sand in blowouts on Plainfield soils.

CAPABILITY UNIT VIIIw–15

Only Marsh, a mixture of organic and mineral soil material, is in this unit. It is generally adjacent to streams and lakes. It is flooded throughout most of the year and is very poorly drained. The plant cover is mainly cattails, bulrushes, and other water-tolerant plants.

Marsh is very poorly suited to crops and pasture, but it can be used as wildlife habitat or for recreation. It also serves as a valuable storage basin for runoff water. Marsh hay can be harvested in some areas in winter.

CAPABILITY UNIT VIIIs–10

Only Rock land and Sandy land are in this unit. Rock land is steep and very steep, has many bedrock outcrops, is generally well drained, and has very rapid runoff. Sandy land consists of fill and cut or borrow areas of raw, infertile soil material. It is generally nearly level, is rapidly permeable, and has low fertility and available water capacity. Both soils are droughty and nearly bare, except for a sparse growth of trees or shrubs and grasses. They are used only as a wildlife habitat or for recreation.

Yield predictions

Predicted yields per acre of the principal crops on variable soils in Columbia County are listed in table 2. The yields are averages of those expected over a period of years under a high level of management *(22)*. The predictions are based on interviews with farmers, on results obtained by the agricultural experiment stations, and on observations by soil scientists and other farm workers who are familiar with the soils.

Under high level management, surface and internal drainage is adequate; soils are limed to about pH 6.5, and fertilizer is applied according to the needs indicated by soil tests; seedbed preparation and proper

TABLE 2.—*Predicted average yields per acre of principal crops, on arable soils, under high level management*

Soil	Corn for grain	Corn for silage	Oats [1]	Alfalfa-brome hay [2]	Blue-grass pasture	Soil	Corn for grain	Corn for silage	Oats [1]	Alfalfa-brome hay [2]	Blue-grass pasture
	Bu	*Tons*	*Bu*	*Tons*	*AUD* [3]		*Bu*	*Tons*	*Bu*	*Tons*	*AUD* [3]
Adrian muck	90	15	--	--	--	Dresden loam, 12 to 20 percent slopes, eroded	75	13	55	2.5	75
Alluvial land, sandy [4]	60	10	45	2.5	50	Friesland fine sandy loam, 1 to 6 percent slopes	110	18	75	4.5	150
Alluvial land, sandy, wet [4]	60	10	45	--	50	Gilford fine sandy loam, stratified substratum, 0 to 3 percent slopes	90	14	60	--	75
Alluvial land, loamy [4]	95	15	65	3.5	100	Granby loamy sand	60	10	45	--	50
Alluvial land, loamy, wet [4]	--	--	--	--	100	Grellton fine sandy loam, 1 to 6 percent slopes	105	17	70	4.0	125
Atterberry silt loam, 0 to 2 percent slopes	125	19	80	5.0	150	Grellton fine sandy loam, 6 to 12 percent slopes, eroded	90	14	65	3.5	100
Atterberry silt loam, 2 to 6 percent slopes	120	19	75	4.5	150	Grellton fine sandy loam, mottled subsoil variant, 0 to 4 percent slopes	105	17	70	3.5	125
Baraboo silt loam, 2 to 6 percent slopes, eroded	100	16	70	3.5	125	Griswold silt loam, 2 to 6 percent slopes, eroded	105	17	70	4.0	125
Baraboo silt loam, 6 to 12 percent slopes, eroded	90	14	65	3.0	100	Griswold silt loam, 6 to 12 percent slopes, eroded	90	14	65	3.5	100
Baraboo silt loam, 12 to 20 percent slopes	80	13	60	3.0	100	Griswold silt loam, 12 to 20 percent slopes, eroded	80	13	60	3.0	75
Barry silt loam, 0 to 3 percent slopes	115	18	75	--	150	Houghton muck	100	16	--	--	--
Boone loamy fine sand, 6 to 12 percent slopes	--	--	--	1.5	30	Joy silt loam, 0 to 4 percent slopes	130	20	75	5.0	150
Boots muck	90	15	--	--	--	Kibbie fine sandy loam, 0 to 4 percent slopes	105	17	70	4.5	125
Boyer loamy sand, 0 to 2 percent slopes	70	12	50	2.5	75	Knowles silt loam, 2 to 6 percent slopes	100	16	70	3.5	100
Boyer loamy sand, 2 to 6 percent slopes	70	12	50	2.5	75	Knowles silt loam, 6 to 12 percent slopes, eroded	90	14	65	3.0	75
Boyer loamy sand, 6 to 12 percent slopes, eroded	65	11	50	2.0	50	Knowles silt loam, 12 to 20 percent slopes, eroded	80	13	60	3.0	75
Boyer loamy sand, 12 to 30 percent slopes, eroded	55	10	45	2.0	50	Lapeer fine sandy loam, 2 to 6 percent slopes	95	15	65	3.5	125
Boyer fine sandy loam, 0 to 2 percent slopes	80	14	60	2.5	100	Lapeer fine sandy loam, 6 to 12 percent slopes, eroded	85	14	60	3.0	100
Boyer fine sandy loam, 2 to 6 percent slopes	75	13	55	2.5	100	Lapeer fine sandy loam, 12 to 20 percent slopes, eroded	75	13	55	2.5	75
Briggsville loam, 2 to 8 percent slopes	100	16	75	5.0	125	Lapeer fine sandy loam, 20 to 30 percent slopes, eroded	--	--	--	--	75
Briggsville silt loam, silty subsoil variant, 1 to 6 percent slopes, eroded	115	18	80	5.0	125	Lorenzo loam, 2 to 6 percent slopes	80	13	55	2.5	100
Channahon silt loam, 2 to 6 percent slopes	80	13	55	2.0	75	Lorenzo loam, 6 to 12 percent slopes, eroded	70	12	50	2.5	75
Channahon silt loam, 6 to 12 percent slopes, eroded	70	12	50	2.0	75	Lorenzo loam, 12 to 20 percent slopes, eroded	--	--	--	2.0	50
Chelsea loamy fine sand, 1 to 6 percent slopes	55	10	45	2.5	50	Marcellon loam, 1 to 6 percent slopes	115	18	75	4.0	150
Chelsea loamy fine sand, 6 to 12 percent slopes	--	--	--	2.0	50	Marshan loam	100	16	65	--	100
Colwood fine sandy loam, 0 to 3 percent slopes	105	17	70	--	100	McHenry silt loam, 2 to 6 percent slopes, eroded	105	17	70	4.0	150
Dodge silt loam, 2 to 6 percent slopes, eroded	110	18	75	4.5	150						
Dodge silt loam, 6 to 12 percent slopes, eroded	95	15	65	4.0	100						
Dodge silt loam, 12 to 20 percent slopes, eroded	85	14	60	3.0	100						
Dresden loam, 1 to 6 percent slopes	95	15	65	3.5	100						
Dresden loam, 6 to 12 percent slopes, eroded	85	14	60	3.0	75						

TABLE 2.—*Predicted average yields per acre of principal crops, on arable soils, under high level management*—Continued

Soil	Corn for grain	Corn for silage	Oats [1]	Alfalfa-brome hay [2]	Blue-grass pasture
	Bu	*Tons*	*Bu*	*Tons*	*AUD* [3]
McHenry silt loam, 6 to 12 percent slopes, eroded	90	14	65	3.5	125
McHenry silt loam, 12 to 20 percent slopes, eroded	80	13	60	3.0	100
Military fine sandy loam, 2 to 6 percent slopes	95	15	65	3.5	100
Military fine sandy loam, 6 to 12 percent slopes, eroded	85	14	60	3.0	75
Military fine sandy loam, 12 to 20 percent slopes, eroded	75	13	55	2.5	50
Morocco loamy sand, 0 to 3 percent slopes	60	10	45	2.5	50
Mt. Carroll silt loam, 12 to 20 percent slopes, eroded	95	15	65	3.5	100
Mt. Carroll silt loam, benches, 0 to 2 percent slopes	120	19	80	5.0	150
Mt. Carroll silt loam, benches, 2 to 6 percent slopes	115	18	75	4.5	150
Mt. Carroll silt loam, benches, 6 to 12 percent slopes, eroded	105	17	70	4.0	150
Northfield sandy loam, 2 to 6 percent slopes	75	13	55	2.5	75
Northfield sandy loam, 6 to 12 percent slopes	65	11	50	2.5	50
Okee loamy fine sand, 2 to 6 percent slopes	75	13	50	3.0	75
Okee loamy fine sand, 6 to 12 percent slopes	70	12	50	2.5	75
Oshtemo loamy sand, 0 to 2 percent slopes	70	12	50	2.5	75
Oshtemo loamy sand, 2 to 6 percent slopes	70	12	50	2.5	75
Oshtemo loamy sand, 6 to 12 percent slopes, eroded	65	11	50	2.0	60
Oshtemo loamy sand, 12 to 20 percent slopes, eroded	55	10	45	2.0	50
Ossian silt loam, 0 to 3 percent slopes	115	18	75	--	100
Otter silt loam [4]	105	17	70	--	120
Palms muck	105	17	--	--	--
Plainfield loamy fine sand, 0 to 2 percent slopes	55	10	45	2.5	40
Plainfield loamy fine sand, 2 to 6 percent slopes	55	10	45	2.5	40
Plainfield loamy fine sand, 6 to 12 percent slopes	--	--	--	2.0	30
Plainfield loamy fine sand, loamy substratum, 2 to 6 percent slopes	55	10	45	2.5	50
Plainfield loamy fine sand, loamy substratum, 6 to 12 percent slopes	--	--	--	2.0	40
Plano silt loam, 0 to 2 percent slopes	130	20	80	5.0	150
Plano silt loam, 2 to 6 percent slopes	125	19	75	5.0	150
Plano silt loam, 6 to 12 percent slopes, eroded	110	18	75	4.5	130
Poygan silt loam, 0 to 3 percent slopes	100	16	65	--	100
Puchyan loamy fine sand, 2 to 6 percent slopes	75	13	50	3.0	75
Puchyan loamy fine sand, 6 to 12 percent slopes	65	11	45	2.5	50
Ringwood silt loam, 1 to 6 percent slopes, eroded	110	18	75	4.0	120
Ringwood silt loam, 6 to 12 percent slopes, eroded	95	15	65	3.5	100
Ripon silt loam, 2 to 6 percent slopes	110	18	75	4.0	120
Ripon silt loam, 6 to 12 percent slopes, eroded	95	15	65	3.5	100
Rodman gravelly loam, 2 to 12 percent slopes	--	--	--	--	75
Rodman gravelly loam, 12 to 20 percent slopes	--	--	--	--	50
Rotamer loam, 2 to 6 percent slopes	80	14	60	3.0	120
Rotamer loam, 6 to 12 percent slopes, eroded	70	12	55	2.5	100
Rotamer loam, 12 to 20 percent slopes, eroded	--	--	--	1.5	80
St. Charles silt loam, 0 to 2 percent slopes	125	19	80	5.0	150
St. Charles silt loam, 2 to 6 percent slopes, eroded	115	18	75	4.5	150
St. Charles silt loam, 6 to 12 percent slopes, eroded	105	17	70	4.0	120
St. Charles silt loam, 12 to 20 percent slopes, eroded	95	15	65	3.5	100
St. Charles silt loam, 20 to 30 percent slopes	--	--	--	--	100
Salter fine sandy loam, 0 to 2 percent slopes	90	14	60	3.0	75
Salter fine sandy loam, 2 to 6 percent slopes	85	14	60	3.0	75
Salter fine sandy loam, 6 to 12 percent slopes, eroded	70	12	55	2.5	50
Salter fine sandy loam, 12 to 20 percent slopes, eroded	60	10	45	2.5	50
Salter fine sandy loam, dark surface variant, 1 to 6 percent slopes	95	15	65	3.5	100
Saybrook silt loam, 2 to 6 percent slopes, eroded	115	18	75	4.5	150

TABLE 2.—*Predicted average yields per acre of principal crops, on arable soils, under high level management*—Continued

Soil	Corn for grain	Corn for silage	Oats [1]	Alfalfa-brome hay [2]	Bluegrass pasture
	Bu	*Bu*	*Tons*	*Tons*	*AUD* [3]
Saybrook silt loam, 6 to 12 percent slopes, eroded	105	17	70	4.0	120
Saybrook silt loam, 12 to 20 percent slopes, eroded	90	14	60	3.0	100
Seaton silt loam, 0 to 2 percent slopes	120	19	80	5.0	150
Seaton silt loam, 2 to 6 percent slopes, eroded	115	18	75	4.5	150
Seaton silt loam, 6 to 12 percent slopes, eroded	105	17	70	4.0	120
Seaton silt loam, 12 to 20 percent slopes, eroded	95	15	65	3.5	100
Sisson fine sandy loam, 0 to 2 percent slopes	110	18	75	4.5	120
Sisson fine sandy loam, 2 to 6 percent slopes	105	17	70	4.0	120
Sisson fine sandy loam, 6 to 12 percent slopes, eroded	90	14	65	3.5	100
Sisson fine sandy loam, 12 to 20 percent slopes, eroded	80	13	60	3.0	75
Sisson fine sandy loam, 20 to 30 percent slopes	--	--	--	--	75
Sparta loamy fine sand, 1 to 6 percent slopes	55	10	45	2.5	50
Troxel silt loam, 0 to 3 percent slopes	130	20	80	5.0	150
Tustin loamy fine sand, 2 to 6 percent slopes	80	14	60	3.0	100
Tustin loamy fine sand, mottled subsoil variant, 0 to 4 percent slopes	80	14	60	3.0	80
Wacousta mucky silt loam	100	17	70	--	100
Wallkill silt loam [4]	95	16	65	--	100
Wasepi fine sandy loam, 0 to 3 percent slopes	80	13	55	2.5	50
Winneshiek fine sandy loam, 2 to 6 percent slopes	100	16	65	3.5	100
Winneshiek fine sandy loam, 6 to 12 percent slopes, eroded	85	14	60	3.0	80
Wyocena loamy sand, 2 to 6 percent slopes	70	12	50	2.5	75
Wyocena loamy sand, 6 to 12 percent slopes, eroded	65	11	50	2.5	60
Wyocena loamy sand, 12 to 20 percent slopes, eroded	--	--	--	2.0	50
Wyocena sandy loam, 2 to 6 percent slopes	75	13	55	2.5	100
Wyocena sandy loam, 6 to 12 percent slopes, eroded	70	12	55	2.5	80
Wyocena sandy loam, 12 to 20 percent slopes, eroded	--	--	--	2.0	60
Wyocena fine sandy loam, sandstone substratum, 2 to 6 percent slopes	75	13	55	2.5	80
Wyocena fine sandy loam, sandstone substratum, 6 to 12 percent slopes, eroded	70	12	55	2.5	60
Wyocena fine sandy loam, sandstone substratum, 12 to 20 percent slopes, eroded	--	--	--	2.0	50
Yahara fine sandy loam, 0 to 4 percent slopes	90	15	60	3.5	120

[1] Yields are for oats seeded with a legume-grass mixture. Higher yields can be obtained, but usually a higher yield of oats results in a poorer stand of the legume-grass mixture.

[2] Yields, in tons dry weight, are for hay cut from first- or second-year stands.

[3] Animal-unit-days expresses the carrying capacity of pasture. It is the number of animal units carried per acre multiplied by the number of days the pasture is grazed during a single grazing season without injury to the sod. An acre of pasture that provides 30 days of grazing for 2 cows has a carrying capacity of 60 animal-unit-days.

[4] Protected from stream overflow.

planting methods are timely and adequate; harvesting is timely and careful; erosion control measures are installed and maintained; cropping systems are adapted to the soil and the slope; and weeds and insects are controlled.

Corn.—Fertilizer is applied according to soil tests based on the expected production of a particular soil over a period of years. Abundant organic matter is supplied by returning crop residue and applying barnyard manure. Good soil structure is maintained through minimum tillage. Corn of suitable relative maturity is grown. Seeding rates are adjusted to get a plant population adequate to produce the expected yield. Weeds and harmful insects are controlled thoroughly.

Oats.—Fertilizer is applied according to soil tests. Clean, viable seeds of adapted varieties are planted at recommended rates and depths as early in spring as possible. Only short, stiff-straved varieties are planted on fertile soils. Oat stubble is clipped and removed after harvest.

Alfalfa-brome hay or bluegrass pasture.—Only clean, viable seed is planted. Only suitable seeding mixtures are used. Oats is removed for fresh feed, silage, or hay if seeding is threatened by lodging or drought. Hay is cut early, when it is of higher quality. Stands are topdressed each year with a maintenance application of fertilizer. Grazing and cutting are avoided from early in September to the middle of October. Insects

and weeds are thoroughly controlled. Grazing is carefully managed.

Soils and Woodland [2]

At the time of settlement, most of Columbia County was covered with a stand of open-grown timber, intermingled with prairie grasses. The trees were predominantly oak and scattered other hardwoods. About 20 percent of the land area was open grassland, mainly big bluestem, little bluestem, indiangrass, and switchgrass. Small areas of wet soils supported sedge, bluejoint grass, and cordgrass. The organic soils supported a stand of tamarack and lowland hardwoods (*3*).

Subsequent farming and the control of wildfire favored the growth of hardwood trees other than oak and eliminated much of the prairie grass. A 1958 inventory of the forest resources by the Wisconsin Conservation Department determined the acreage of commercial timber in the county at about 120,000 acres, or about 24 percent of the land area (*23*).

Red oak, white oak, bur oak, and northern pin oak are the most important species in terms of volume produced and area occupied in the forests of Columbia County. Other important species are maple, ash, aspen, and elm. In the 1958 inventory, about 40 percent of the forested acreage was classified as brush. The vegetation of this brushland, if protected from grazing, can be expected to change through natural succession to a mixed hardwood forest stand.

A considerable acreage, once farmed, has been planted to red pine, white pine, and jack pine. These plantings aided in conserving soil and water as well as in providing habitat for wildlife and adding to the esthetic value of the land. They have been especially important on sandy soils, such as Plainfield, Wyocena, Oshtemo, and Boyer soils, Some planted areas are managed for the production of Christmas trees.

Table 3 shows the principal wood crops and soil-related limitations for each woodland group in the county.

Woodland suitability groups

In order to assist owners in planning the use of their soils for wood crops, the soils of Columbia County have been grouped according to their suitability for trees. Each group is made up of soils that are suited to the same kinds of trees; that require approximately the same kind of management when the vegetation on them is similar; and that have about the same potential productivity. The soils in each woodland suitability group can be identified by referring to the "Guide to Mapping Units" at the back of this survey.

Each woodland group is identified by a three-part symbol, for example, 2d1 or 3r2. The first number indicates relative potential productivity of the soils in the group; 1 means high, 2 moderately high, 3 moderate, 4 moderately low, 5 low, and 6 unproductive. The ratings are based on growth potential expressed as site index, which is the average height of dominant and codominant trees of a given species at age 50 years. Site indexes for some of the more important species and soils have been measured. Others are estimated from measurements made on similar soils and species.

Site indexes are based on recognized site index curves for silver maple (*11*), red oak (*14*), sugar maple (*4*), red maple (*6*), white oak (*14*), black oak (*14*), northern pin oak (*14*), bur oak(*14*), aspen (*7*), and tamarack (*8, 12*).

Annual yields were estimated from yield tables based on site index for silver maple (*11*), upland oak (*14*), northern hardwoods (*13*), aspen (*10*), and tamarack (*8, 12*).

The second part of the symbol, a small letter, indicates an important soil property that imposes a slight to severe limitation in managing the soils of the group for wood crops. The letter *w* indicates excessive wetness. Excessive water, either seasonally or yearlong, causes significant limitations in woodland use or management. The soils have restricted drainage, a high water table, or an overflow hazard, which adversely affects either stand development or management. The letter *d* indicates a restricted root zone. The soils are shallow over hard rock, a hardpan, or other layers that restrict roots. The letter *c* indicates clayey soils. The kind or amount of clay in the upper part of the profile of these soils restricts or limits growth of trees. The letter *s* indicates sandy soils. These soils are dry and have little or no textural B horizon and moderate to severe restrictions or limitations for woodland use or management. These soils impose equipment limitations, have low available water capacity, and normally are low in available plant nutrients. The letter *f* indicates fragmental or skeletal soils. These soils contain a large number of coarse fragments, including more than 2 millimeters, but less than 10 inches, in diameter. The letter *r* indicates relief. These soils are restricted or limited only by steepness of slope. The letter *o* indicates slight or no limitations and no significant restrictions for woodland use or management.

The erosion hazard, the limitation to use of equipment, and the hazard of seedling mortality, as shown in table 3, are expressed as *slight, moderate,* and *severe.*

Erosion hazard refers to the potential hazard of soil loss in woodland. The hazard is *slight* if expected loss of soil is small; *moderate* if some loss is expected and care is needed during logging and construction; and *severe* if special methods in logging and harvest are needed to prevent excessive loss of soil.

The equipment limitation is rated on the basis of soil characteristics that restrict or prohibit the use of equipment commonly used in tending and harvesting the trees. The most limiting soil characteristics in Columbia County are excessive soil wetness, slope, and texture of the surface layer. *Slight* indicates no restriction in the kind of equipment or in the time of year it is used; *moderate* means that use of equipment is restricted for less than 3 months of the year; and *severe* means that special equipment is needed and its use is restricted for more than 3 months of the year.

Seedling mortality refers to the expected degree of

[2] By GEORGE W. ALLEY, forester, Soil Conservation Service, Madison, Wis.

TABLE 3.—*Wood crops and*

[Dashes indicate no

Woodland group and map symbols and soils not classified	Potential productivity			
	Trees	Average site index[1]	Number of plots	Yearly growth per acre
				Board feet
Group 1w5: CoA, Ot.	Red and silver maple	78	5	180
	Northern red oak	78	2	300
Group 1o1: KbA, SaA, SaB2, SaC2, SbA, SbB, SbC2, ScB, SfA, SfB2, SfC2, YaA.	Red oak	--	--	--
	Sugar maple	67±3.4	7	110
	Northern red oak	70±7.0	9	250
Group 1r2: SaD2, SaE, SbD2, SfD2.	Northern red oak	72	3	265
	Sugar maple	65	0	110
Group 2c1: BsB, BtB2.	Northern red oak	70	0	250
	Sugar maple	65	0	110
Group 2w5: AtA, AtB	Red oak	65	0	220
Group 2s1: OkB, OkC	Red oak	65	0	220
Group 2o1: BaB2, BaC2, DoB2, DoC2, DrB, DrC2, GeB, GeC2, GnA, KnB, KnC2, MaB, MeB2, MeC2, MnB, MnC2, MtA, MtB, MtC2, SnA, SnB, SnC2, TsA, WnB, WnC2.	Northern red oak	62	4	200
	Sugar maple	57	3	80
Group 2r2: BaD, BaE, DoD2, DrD2, KnD2, MeD2, MnD2, MrD2, SnD2, SnE.	Northern red oak	67	1	230
Group 3w4: Gb, MoA.	Silver maple	80	0	160
	Golden aspen	60	0	150
Group 3w5: OsA, PoA, Wa	Silver maple	80	0	160
Group 3d1: LoB, LoC2, NoB, NoC.	Northern red oak	55	5	140
	White oak	55	1	140
Group 3d2: LoD2, NoE.	Northern red oak	55	0	140
	White oak	55	0	140
Group 3s1: Ae, ChB, ChC, PeC2, PfA, PfB, PfC, PkB, PkC, SpB.	Red pine	55	0	300
	Eastern white pine	50	0	220
	Jack pine, northern pin oak	60	0	95
Group 3s2: PfD, PkD.	Red pine	55	0	300
	Eastern white pine	50	0	220
	Jack pine, northern pin oak	60	0	95
Group 3o1: Ag, BpA, BpB, BpC2, BrA, BrB, LaB, LaC2, OmA, OmB, OmC2, PuB, PuC, TuB, TvA, WcA, WoB, WoC2, WxB, WxC2, WyB, WyC2.	Red oak	59	4	185
Group 3r2: BpD2, LaD2, LaE2, OmD2, WoD2, WoE, WxD2, WyD2, WyE.	Red oak	55	0	160
Group 4w4: Af, GaA.	Quaking aspen	50	0	80
	Jack pine	45	0	60
Group 4w5: Ah, BbA, Mc, Wb	Silver maple	70	0	130
Group 4d2: Rk	Black oak	45	0	100
Group 4s1: BnC	Northern pin oak	45	0	100

soil-related limitations

available data]

Trees suitable for planting	Equipment limitation	Erosion hazard	Seedling mortality
Silver maple, green ash	Moderate	Slight	Moderate.
White pine, red pine, white spruce	Slight	Slight	Slight.
White pine, red pine	Moderate	Moderate	Slight on north- and east-facing slopes, moderate on south- and west-facing slopes.
White pine, red pine, white spruce	Slight	Slight	Slight.
White spruce, eastern white pine, red pine	Slight	Slight	Slight.
Eastern white pine, red pine	Slight	Slight	Slight.
Red pine, white pine, white spruce	Slight	Slight	Slight.
Red pine, white pine	Moderate	Moderate	Slight on north- and east-facing slopes; moderate on south- and west-facing slopes.
Silver maple, green ash	Slight	Slight	Slight.
Silver maple, green ash	Slight	Slight	Slight.
Red pine, eastern white pine	Slight	Slight	Slight.
Red pine, eastern white pine, eastern redcedar	Moderate	Moderate	Slight on north- and east-facing slopes, moderate on south- and west-facing slopes.
Red pine, eastern white pine, jack pine	Slight	Slight	Slight.
Red pine, eastern white pine, jack pine	Slight	Slight	Slight.
Red pine, white pine	Slight	Slight	Slight.
Red pine, white pine	Moderate	Moderate	Slight on north- and east-facing slopes, moderate on south- and west-facing slopes.
Quaking aspen, jack pine, white spruce	Moderate	Slight	Moderate.
Silver maple, green ash, poplar sp.	Moderate	Slight	Moderate.
Red pine, eastern redcedar	Severe	Severe	Moderate on north- and east-facing slopes, severe on south- and west-facing slopes.
Red pine, jack pine	Slight	Slight	Severe.

TABLE 3.—*Wood crops and*

Woodland group and map symbols and soils not classified	Potential productivity			
	Trees	Average site index[1]	Number of plots	Yearly growth per acre
				Board feet
Group 4s2: BnE	Northern pin oak	45	0	100
Group 4f1: RoC	Black oak	45	0	100
Group 4f2:: RoD, RoE	Black oak	45	0	100
Group 4o1: JoA	Silver maple	70	0	130
Group 5d1: CaB, CaC2	Bur oak	40	0	80
Group 5d2: CaE2	Bur oak	40	0	80
Organic soils that may support forest growth:[2] Ad, Bo, Ho, Pa	Northern white-cedar	35	3	50
	Tamarack	50	2	100
Soils not naturally forested:[3] FrB, GrB2, GrC2, GrD2, PnA, PnB, PnC2, RdB2, RdC2, RoB, ReC2, RtB, RtC2, RtD2, RtE2, SeB2, SeC2, SeD2.				
Unproductive soils:[4] Mb, Sd.				

[1] Site index is estimated if figure in column "Number of plots" is zero.
[2] These soils are so variable in their response to forest management that they are not classified by woodland group. In addition to the species listed, they may support such water-tolerant species as red maple, silver maple, and American elm. Rate of growth of trees on these organic soils is frequently low and highly variable. Occasionally silver maple, red maple, and white ash make rapid growth.

mortality of planted seedlings as influenced by kinds of soil. Considered in the ratings are excessive soil wetness, hazard of flooding, slope and aspect, texture and structure, and plant competition. Normal rainfall, good planting stock, and proper planting are assumed. A rating of *slight* indicates an expected loss of less than 25 percent of the planted seedlings; *moderate*, a loss of 25 to 50 percent of the seedlings; and *severe*, a loss of more than 50 percent of the seedlings.

The third part of the symbol indicates the degree of hazard or limitation to be considered in management.

Numerals 1, 2, 3 refer to slope and apply to subclasses *o*, *c*, *s*, *d*, *f*, and *r*. The numeral *1* indicates a slope of less than 12 percent and generally only a slight erosion hazard and equipment limitation; the numeral *2* indicates a slope of 12 to 30 percent and a moderate to severe erosion hazard and equipment limitation depending on the subclass, or soil properties; and the numeral *3* indicates a slope of more than 30 percent, and a severe erosion hazard and equipment limitation. The numerals 4, 5, and 6 indicate soil factors and apply only to the *w* subclass. The numeral *4* refers to deep, poorly drained to somewhat poorly drained, sandy soils; the numeral *5* refers to poorly drained to somewhat poorly drained soils that have a loamy or clayey subsoil; and the numeral *6* indicates deep organic soils.

Landscaping and windbreaks

This section contains information about some of the trees, shrubs, and vines used in landscaping sites for homes, schools, industry, and recreation areas. Also, it provides information on species suitable for windbreak use around farmsteads or open fields.

A significant acreage in Columbia County is subject to soil blowing. The sandy Plainfield, Oshtemo, and Wyocena soils and the organic Adrian, Boots, Houghton, and Palms soils require the protection of windbreaks and careful agronomic management to hold down the loss of soil through blowing.

The height of pine windbreaks on some of the sandy soils has been measured. At 30 years of age white pine (*9*) on Plainfield soils reached a height of 38 to 42 feet, red pine 34 to 37 feet, and a single row of jack pine 36 feet. Three rows of white pine on Boyer soils reached a height of 40 feet at age 25 years.[3]

Trees and shrubs of different species differ widely in suitability to different soils and to the site conditions. The soils in the county have been assigned to four tree and shrub groups, mainly on the basis of the degree and length of time the soil is saturated with water and the available water capacity.

Each soil in a specified group has similar suitability for tree, shrub, and vine plantings. The soils in a tree and shrub group can be identified by referring to the "Guide to Mapping Units" at the back of this survey.

Table 4 lists trees suitable for specified uses in the four tree and shrub groupings. Table 5 shows the uses, growth form, and esthetic value of shrubs and vines by tree and shrub planting group. Plants listed in the tables are only a partial list of the plants suited to soils in the county. Many plants serve a dual purpose of landscaping and of providing food and cover for wildlife.

[3] Unpublished data from the Windbreak-Soil Site Study, Soil Conservation Service, Madison, Wis., 1972.

soil-related limitations—Continued

Trees suitable for planting	Equipment limitation	Erosion hazard	Seedling mortality
Red pine, jack pine	Slight	Slight	Severe.
Red pine, jack pine	Slight	Slight	Moderate to severe.
Eastern redcedar	Moderate to severe	Moderate to severe	Moderate to severe.
Silver maple, green ash	Moderate	Slight	Moderate.
Red pine, eastern redcedar	Slight	Slight	Moderate to severe.
Red pine, eastern redcedar	Moderate to severe	Moderate to severe	Moderate to severe.
None	Severe	Slight	Severe.

[3] The native vegetation on these soils was predominantly prairie grasses and forbs and a few scattered trees, mostly white oak and bur oak. A few areas have filled in with white, bur, and red oaks. Most of the acreage, however, is used for production of farm crops.

[4] Not suited to forestry use.

Soils and Wildlife [4]

[4] LAVERNE C. STRICKER, biologist, Soil Conservation Service, helped prepare this section.

The soils of Columbia County vary widely in physical and chemical characteristics that affect the kind and amount of vegetation and wildlife they can support. Research has shown a direct relationship between soil fertility and wildlife numbers and vigor. This correlation applies to upland and wetland soils, plants, and animals, both domestic animals and wildlife.

Food and cover plantings in areas used primarily or secondary for wildlife production are expected to encourage wildlife. Wildlife benefits from such practices as stripcropping, fertilization, and tree plantings in fields, pasture, and woodland. The soils in the county have a high potential for wildlife, but because they are suitable for fairly intensive farming, they provide little wildlife habitat.

Wildlife groups

For interpretation purposes, the soils have been grouped according to a statewide system of grouping and identification. Of the nine groups in the statewide system, groups 1, 2, 3, 4, 5a, 5b, 6, 7, and 8 are recognized in Columbia County. Groups 5a, 5b, 6, and 7 make up nearly all of the wetlands. Figure 21 shows the distribution of the wetlands throughout the county.

The soil survey of Columbia County indicates that about 31 percent of the county, or 153,800 acres is designated as wet soils. These soils are saturated for significant periods at a depth of less than 3 feet and are subject to flooding. According to a 1958 survey, less than one-third of the original wetland acreage, or only 41,000 acres, remains in its natural condition. The species and number of wildlife remaining in the county have changed accordingly.

In table 6, the wildlife groups of soils in Columbia County are rated according to their suitability for producing various elements of wildlife habitat, for example, grain and seed crops, grasses and legumes, wild herbaceous plants, hardwood trees and shrubs, coniferous trees, wetland plants for food and cover, and shallow and deep water developments.

Grain and seed crops are corn, oats, sorghums, wheat, barley, rye, soybeans, and other crops used as food and cover for wildlife.

Grasses and legumes are bluegrass, bromegrass, timothy, and fescue, and legumes such as alfalfa, birdsfoot trefoil, red clover, sweet clover, and vetch that are used by wildlife for food and cover.

Wild herbaceous plants are native or introduced grasses, legumes, and forbs that provide food and cover for upland wildlife and are mainly established by natural means. Such plants as bluegrass, prairie grasses, roundhead lespedeza, beggars tick, aster, and goldenrod are important in this group.

Woody plants are shrubs, hardwood trees, and coniferous trees. Shrubs are low-growing woody plants, including conifers less than 8 feet tall, that furnish fruit, seeds, browse, and cover for wildlife. Examples are viburnum, dogwood, and hazelnut. Hardwood trees, such as oaks, maples, cherry (*5*), and nut trees, furnish mast, fruit, seeds, dens, cover, and browse for wildlife. Conifers trees more than 8 feet tall, such as pines, firs, spruce, tamarack, and cedar, furnish seeds, fruit, browse, and cover for wildlife.

TABLE 4.—*Trees suitable*

[The first letter in parentheses following the species indicates tree height; S is less than 30 feet; M, 30 to 60; L, more than 60. The Alluvial land, loamy, Marsh, and Sandy

Tree and shrub group, soil series, and map symbols	Shade	Street borders
Group 1: Moderately deep and deep, moderately well drained or well drained, medium-textured soils that have medium to high available water capacity. Baraboo: BaB2, BaC2, BaD, BaE. Briggsville: BsB, BtB2. Dodge: DoB2, DoC2, DoD2. Dresden: DrB, DrC2, DrD2. Friesland: FrB. Grellton: GeB, GeC2. Griswold: GrB2, GrC2, GrD2. Knowles: KnB, KnC2, KnD2. Lapeer: LaB, LaC2, LaD2, LaE2. Lorenzo: LoB, LoC2, LoD2. McHenry: MeB2, MeC2, MeD2. Military: MnB, MnC2, MnD2. Mt. Carroll: MrD2, MtA, MtB, MtC2. Plano: PnA, PnB, PnC2. Puchyan: PuB, PuC. Ringwood: RdB2, RdC2. Ripon: ReB, ReC2. Rotamer: RtB, RtC2, RtD2, RtE2. St. Charles: SaA, SaB2, SaC2, SaD2, SaE. Salter: SbA, SbB, SbC2, SbD2, ScB. Saybrook: SeB2, SeC2, SeD2. Seaton: SfA, SfB2, SfC2, SfD2. Sisson: SnA, SnB, SnC2, SnD2, SnE. Troxel: TsA. Winneshiek: WnB, WnC2.	American beech (LO) Sugar maple (LO) Red maple (MO) Red oak (LR) White oak (LR) Basswood (LO) Hackberry (MR) White ash (LO) Sycamore (LO) Bur oak (LR) Norway maple (MR) Silver maple (LO) Thornless honeylocust (MO)	Norway maple (MR) Southern pin oak (MP) Thornless honeylocust (MO) Basswood (LO) White ash (LO) Sugar maple (LO) Hackberry (MR) Red maple (MO)
	American beech (LO) Sugar maple (LO) Red maple (MO) Red oak (LR) Hackberry (MR) White ash (LO) Basswood (LO)	Norway maple (MP) White ash (LO) Basswood (LO) Sugar maple (LO)
Group 2: Somewhat excessively drained to excessively drained, coarse-textured or shallow soils that have low water capacity. Boone: BnC, BnE. Boyer: BpA, BpB, BpC2, BpD2, BrA, BrB. Channahon: CaB, CaC2, CaE2. Chelsea: ChB, ChC. Northfield: NoB, NoC, NoE. Okee: OkB, OkC. Oshtemo: OmA, OmB, OmC2, OmD2. Plainfield: PeC2, PfA, PfB, PfC, PfD, PkB, PkC, PkD. Rock land: Rk. Sandy land: Sd. Rodman: RoC, RoD, RoE. Sparta: SpB. Tustin: TuB, TvA. Wyocena: WoB, WoC2, WoD2, WoE, WxB, WxC2, WxD2, WyB, WyC2, WyD2, WyE.	Bur oak (LR) Hackberry (MR) Black oak (LR) Silver maple (LO) Green ash (MO) Thornless honeylocust (MO)	Green ash (MO) White ash (LO) Hackberry (MR) Thornless honeylocust (MO)
	Hackberry (MR)	Hackberry (MR)
Group 3: Somewhat poorly drained and poorly drained mineral soils. Alluvial land, sandy: Ae. Alluvial land, sandy, wet: Af. Alluvial land, loamy, wet: Ah. Atterberry: AtA, AtB. Barry: BbA. Colwood: CoA. Gilford: GaA.	Swamp white oak (LR) Hackberry (MR) Red maple (MO) Basswood (LO) Green ash (MO) White ash (LO) Silver maple (LO) Cottonwood (LO)	Green ash (MO) Basswood (LO) Red maple (MO)

for planting

second letter indicates shape; C is columnar; O, oval; P, pyramidal; Pe, pendulous; R, round. Marshan loam, Morocco loamy sand, land are not in a tree and shrub group]

Trees suitable for—		
Lawns	Hedges and screens	Windbreaks
SUNNY SITES		
Flowering crab (SR) Mountainash (SO) Blue beech (SR) Paper birch (MO) River birch (MO) Russian-olive (SR) Southern pin oak (MP) Serviceberry (SR) Horse chestnut (LR) Norway spruce (LP) Red pine (LP) White pine (LP) White spruce (MP) Black cherry (LO) Blue spruce (LP) Norway spruce (LP) Hawthorn (SR)	Redcedar (SP) White-cedar (MC, P) White pine (LP) White spruce (LP) Lombardy poplar (LC) Russian-olive (SR) Upright yew (SP)	White spruce (MP). White-cedar (MC, P). White pine (LP). Red pine (LP). Norway spruce (LP).
PARTIAL SHADE		
Blue beech (SP) Serviceberry (SR) White pine (LP) White spruce (MP) Blue spruce (LP) Norway spruce (LP)	White-cedar (MC) White pine (LP) White spruce (MP) Upright yew (SP)	White-cedar (MC, P). White pine (LP). White spruce (MP).
SUNNY SITES		
Flowering crab (SR) Paper birch (MO) Redcedar (SP) White pine (LP) White spruce (MP) Red pine (LP) Russian-olive (SR)	Redcedar (SP) Russian-olive (SR) Red pine (LP) White pine (LP) Upright yew (SP) White spruce (MP)	Red pine (LP). White pine (LP). Redcedar (SP).
PARTIAL SHADE		
White pine (LP) White spruce (MP)	Upright yew (SP) White pine (LP) White spruce (MP)	White pine (LP).
SUNNY SITES		
White spruce (MP) Paper birch (MO) Mountainash (SO) Weeping willow (MPe) White-cedar (MP) River birch (MO)	White-cedar (MC) White spruce (MP) Lombardy poplar (LC) Laurel willow (MO)	White-cedar (MC). White spruce (MP). White pine (LP).

TABLE 4.—*Trees suitable*

Tree and shrub group, soil series, and map symbols	Shade	Street borders
Granby: Gb. Grellton, mottled subsoil variant: GnA. Joy: JoA. Kibbie: KbA. Marcellon: MaB. Ossian: OsA. Otter: Ot. Poygan: PoA. Wacousta: Wa. Wallkill: Wb. Wasepi: WcA. Yahara: YaA.	Swamp white oak (LR) Hackberry (MR) Red maple (MO) Basswood (LO) Green ash (MO) White ash (LO)	Green ash (MO) Basswood (LO) Red maple (MO)
Group 4: Very poorly drained organic soils: Adrian: Ad. Boots: Bo. Houghton: Ho. Palms: Pa.	Silver maple (LO) Red maple (MO)	Red maple (MO) Laurel willow (MO)
	Red maple (MO)	None

TABLE 5.—*Shrub and*

[The letter x means that the plant has the kind of characteristics,

Tree and shrub group [1]	Plant species	Shade tolerance	Suitable for—		
			Landscaping	Hedges, screens, windbreaks	Roadside planting
Group 1: Moderately deep and deep, moderately well drained or well drained, medium-textured soils that have moderate to high available water capacity.	Arborvitae (shrub types) (*Thuja* spp.)	Some	x	x	
	Barberry, Japanese (*Berberis thunbergi*)	x	x	x	
	Bittersweet (*Celastrus scandens*)	x	Some		x
	Blackberry, dewberry, blackcap raspberry (*Rubus* spp.)				x
	Chokeberry, black (*Aronia melanocarpa*)	x	x		x
	Cotoneaster (*Cotoneaster* spp.)		x	x	
	Crabapple (*Malus* spp.)		x	x	x
	Currant, Alpine (*Ribes alpinum*)	x	x	x	
	Dogwood, gray (*Cornus racemosa*)	x			x
	Dogwood, Pagoda (*Cornus alternifolia*)	x			x
	Dogwood, redosier (*Cornus stolonifera*)	x	Some		
	Dogwood, roundleaf (*Cornus rugosa*)	x			x
	Dogwood, silky (*Cornus amomum*)	x		x	x
	Elder, American (*Sambucus canadensis*)				x

for planting—Continued

Trees suitable for—		
Lawns	Hedges and screens	Windbreaks
SUNNY SITES		
PARTIAL SHADE		
White spruce (MP) Mountainash (SO)	White-cedar (MC) White spruce (MP)	White-cedar (MC). White spruce (MP).
SUNNY SITES		
White-cedar (MC) White spruce (MP) Weeping willow (MPe)	White-cedar (MC) Laurel willow (MO)	Laurel willow (MO). Poplar selections (LP). Tree lilac (SO). White-cedar (MC).
PARTIAL SHADE		
White-cedar (MC) White spruce (MP)	White-cedar (MC)	White-cedar (MC).

vine planting guide

features, or suitability indicated by the column heading]

Growth characteristics					Esthetic value		
Ground cover	Potential height	Type of plant	Thorny	Thicket forming	Flowers	Fruit or berries	Fall color
	3–7	Shrub					x
	6	Shrub				x	x
x		Vine				x	x
x	1–5	Bramble	x	x	x	x	x
x	1–3	Shrub		x		x	x
	4–8	Shrub				x	x
	25	Shrub			x	x	x
	6–7	Foliage, shrub.			x		
	6–10	Shrub			x	x	x
	10–15	Shrub			x	x	x
	3–9	Shrub		x	x	x	x
x	3–9	Shrub			x	x	x
	6–10	Shrub			x	x	x
	3–10	Shrub		x	x	x	

TABLE 5.—*Shrub and*

Tree and shrub group [1]	Plant species	Shade tolerance	Suitable for—		
			Landscaping	Hedges, screens, windbreaks	Roadside planting
	Filbert (hazelnut) (*Corylus americana*)	x	----------	----------	x
	Forsythia (*Forsythia* spp.)	x	x	----------	----------
	Grape, wild (*Vitis* spp.)	x	----------	----------	x
	Hawthorn or thornapple (*Crataegus* spp.)	x	x	----------	x
	Honeysuckle (shrub types) (*Lonicera* spp.)	x	x	x	----------
	Juniper, creeping (*Juniperus horizontalis*)	----------	x	----------	x
	Juniper, Pfitzer (*J. chinensis pfitzeriana*)	----------	x	----------	----------
	Lilac (*Syringa* spp.)	----------	x	x	x
	Maple, Amur (*Acer ginnala*)	----------	x	x	----------
	Mockorange (*Philadelphus* spp.)	----------	x	x	----------
	Myrtle or periwinkle (*Vinca minor*)	x	x	----------	x
	Ninebark, common (*Physocarpus opulifolius*)	x	x	x	x
Group 2: Somewhat excessively drained or excessively drained, coarse-textured or shallow soils that have low available water capacity.	Arborvitae (shrub types) (*Thuja* spp.)	Some	x	x	----------
	Barberry, Japanese (*Barberis thunbergi*)	x	x	x	----------
	Bayberry or waxmyrtle (*Myrica pensylvanica*)	x	x	----------	----------
	Bittersweet (*Celastrus scandens*)	x	Some	----------	x
	Blackberry, dewberry blackcap raspberry (*Rubus* spp.)	----------	----------	----------	x
	Cotoneaster (*Cotoneaster* spp.)	----------	x	x	----------
	Crabapple (*Malus* spp.)	----------	x	x	x
	Currant, Alpine (*Ribes alpinum*)	x	x	x	----------
	Dogwood, gray (*Cornus racemosa*)	x	----------	----------	x
	Filbert (hazelnut) (*Corylus americana*)	x	----------	----------	x
	Forsythia (*Forsythia* spp.)	x	x	----------	----------
	Grape (*Vitis* spp.)	x	----------	----------	x
	Hawthorn or thornapple (*Crataegus* spp.)	x	x	----------	x
	Honeysuckle (shrub types) (*Lonicera* spp.)	x	x	x	----------
	Juniper, creeping (*Juniperus horizontalis*)	----------	x	----------	x
	Juniper, Pfitzer (*J. chinensis pfitzeriana*)	----------	x	----------	----------
	Lilac (*Syringa* spp.)	----------	x	x	x
	Maple, Amur (*Acer ginnala*)	----------	x	x	----------
	Mockorange (*Philadelphus* spp.)	----------	x	x	----------
	Myrtle or periwinkle (*Vinca minor*)	x	x	----------	x
	Ninebark, common (*Physocarpus opulifolius*)	x	x	x	x
	Olive, autumn (*Elaeagnus umbellata*)	x	x	x	----------
	Peashrub, Siberian (*Caragana arborescens*)	----------	x	x	x

vine planting guide—Continued

Growth characteristics					Esthetic value		
Ground cover	Potential height	Type of plant	Thorny	Thicket forming	Flowers	Fruit or berries	Fall color
	5–8	Shrub		x		x	x
	4–8	Shrub			x		
x		Vine				x	x
	5–20	Shrub	x			x	x
	6–12	Shrub			x	x	x
x	1–2	Shrub	To touch			x	x
	8–10	Shrub					x
	8–10	Shrub		Some	x		
	15+	Tall shrub					x
	6–9	Shrub			x		
x	1	Short vine		Forms mat	x		
	6–9	Shrub		x	x		x
	3–7	Shrub					x
	6	Shrub	x			x	x
x	5–9	Shrub				x	x
x		Vine				x	x
x	1–5	Bramble	x	x	x	x	x
	4–8	Shrub				x	x
	25	Shrub			x	x	x
	6–7	Foliage shrub.			x		
	6–10	Shrub			x	x	x
	5–8	Shrub		x		x	x
	4–8	Shrub			x		
x		Vine				x	x
	5–20	Shrub	x			x	x
	6–12	Shrub			x	x	x
x	1–2	Shrub	To touch			x	x
	8–10	Shrub		Some			x
	8–10	Shrub		Some	x		
	15+	Tall shrub					x
	6–9	Shrub			x		
x	1	Short vine		Forms mat	x		
	6–9	Shrub			x		x
	10–15	Shrub				x	x
	10–15	Shrub				x	x

TABLE 5.—*Shrub and*

Tree and shrub group [1]	Plant species	Shade tolerance	Suitable for—		
			Landscaping	Hedges, screens, windbreaks	Roadside planting
	Pine, mugho (*Pinus mugo mughus*)	----------	x	----------	----------
	Plum, American (*Prunus americana*)	x	----------	x	x
Group 3: Somewhat poorly drained and poorly drained mineral soils.	Arborvitae (shrub types) (*Thuja* spp.)	Some------	x	x	----------
	Bayberry or waxmyrtle (*Myrica pensylvanica*)	x	x	----------	----------
	Chokeberry, black (*Aronia melanocarpa*)	x	----------	----------	x
	Dogwood, gray (*Cornus racemosa*)	x	----------	----------	x
	Dogwood, Pagoda (*Cornus alternifolia*)	x	----------	----------	x
	Dogwood, redosier (*Cornus stolonifera*)	x	Some------	----------	x
	Dogwood, roundleaf (*Cornus rugosa*)	x	----------	----------	x
	Dogwood, silky (*Cornus amomum*)	x	----------	x	x
	Elder, American (*Sambucus canadensis*)	----------	----------	----------	x
	Hawthorn or thornapple (*Crataegus* spp.)	x	----------	----------	x
	Honeysuckle (shrub types) (*Lonicera* spp.)	x	x	x	----------
	Ninebark, common (*Physocarpus opulifolius*)	x	x	x	x
	Olive, autumn (*Elaeagnus umbellata*)	x	----------	x	----------
	Plum, American (*Prunus americana*)	x	----------	x	x
	Russian-olive (*Elaeagnus angustifolia*)	----------	x	x	----------
	Spirea, narrowleaf meadowsweet (*Spiraea alba*)	----------	----------	----------	x
	Spirea, Vanhoutte (*Spiraea vanhouttei*)	x	x	x	----------
	Virburnum, American cranberrybush (*Virburnum trilobum*)	x	x	x	x
	Viburnum, mapleleaf (*Viburnum acerifolium*)	x	----------	----------	x
	Viburnum, nannyberry (*Viburnum lentago*)	x	----------	x	x
	Viburnum, wayfaringtree (*Viburnum lantana*)	x	----------	x	x
	Willows (shrubby types including pussywillows) (*Salix* spp.)	----------	----------	x	x
	Winterberry, common (*Ilex verticillata*)	x	----------	----------	x
Group 4: Very poorly drained organic soils.	Arborvitae (shrub types) (*Thuja* spp.)	Some------	x	x	----------
	Dogwood, redosier (*Cornus stolonifera*)	x	Some------	----------	x
	Dogwood, roundleaf (*Cornus rugosa*)	x	----------	----------	x
	Dogwood, silky (*Cornus amomum*)	x	----------	x	x
	Elder, American (*Sambucus canadensis*)	----------	----------	----------	x
	Honeysuckle (shrub types) (*Lonicera* spp.)	x	x	x	----------
	Ninebark, common (*Physocarpus opulifolius*)	x	x	x	x
	Spirea, narrowleaf meadowsweet (*Spiraea alba*)	----------	----------	----------	x

vine planting guide—Continued

Growth characteristics					Esthetic value		
Ground cover	Potential height	Type of plant	Thorny	Thicket forming	Flowers	Fruit or berries	Fall color
	6–9	Shrub					x
	10–15	Shrub	Some	x	x	x	x
	3–7	Shrub					x
x	5–9	Shrub				x	x
x	1–3	Shrub				x	x
	6–10	Shrub			x	x	x
	10–15	Shrub			x	x	x
	3–9	Shrub			x	x	x
	3–9	Shrub			x	x	x
	6–10	Shrub				x	x
	3–10	Shrub			x	x	
	5–20	Shrub				x	x
	6–12	Shrub			x	x	x
	6–9	Shrub			x		x
	10–15	Shrub				x	x
	10–15	Shrub	x	x	x	x	x
	15+	Shrub	x			x	x
	3–4	Shrub			x		x
	5–6	Shrub			x		x
	7–9	Shrub			x	x	x
	3–5	Shrub			x	x	x
	9–12	Shrub			x	x	x
	8–10	Shrub			x	x	x
	2–8	Shrub					
	6–9	Shrub				x	x
	3–7	Shrub					x
	3–9	Shrub			x	x	x
	3–9	Shrub			x	x	x
	6–10	Shrub				x	x
	3–10	Shrub			x	x	
	6–12	Shrub			x	x	x
	6–9	Shrub			x		x
	3–4	Shrub			x		x

TABLE 5.—*Shrub and*

Tree and shrub group [1]	Plant species	Shade tolerance	Suitable for—		
			Landscaping	Hedges, screens, windbreaks	Roadside planting
	Viburnum, American cranberrybush (*Viburnum trilobum*)	x	x	x	x
	Viburnum, mapleleaf (*Viburnum acerifolium*)	x	----------	----------	x
	Viburnum, nannyberry (*Viburnum lentago*)	x	----------	x	x
	Viburnum, wayfaringtree (*Viburnum lantana*)	x	----------	x	x
	Willows (shrubby types including pussywillows) (*Salix* spp.)	----------	----------	x	x
	Winterberry, common (*Ilex verticillata*)	x	----------	----------	x

[1] See table 4, Trees suitable for planting, for the names of the soils in the tree and shrub groups.

TABLE 6.—*Soils and elements*

Wildlife group, description of soils, soil series, and map symbols	Grain and seed crops	Grasses and legumes	Wild herbaceous plants
Group 1: Well drained to moderately well drained soils that are loamy throughout. Baraboo: BaB2, BaC2, BaD, BaE. Boyer: BrA, BrB. Dodge: DoB2, DoC2, DoD2. Dresden: DrB, DrC2, DrD2. Grellton: GeB, GeC2. Knowles: KnB, KnC2, KnD2. Lapeer: LaB, LaC2, LaD2, LaE2. McHenry: MeB2, MeC2,MeD2. Military: MnB, MnC2, MnD2. Mt. Carroll: MrD2, MtA, MtB, MtC2. St. Charles: SaA, SaB2, SaC2, SaD2, SaE. Salter: SbA, SbB, SbC2, SbD2. Seaton: SfA, SfB2, SfC2, SfD2. Sisson: SnA, SnB, SnC2, SnD2, SnE. Winneshiek: WnB, WnC2. Wyocena: WxB, WxC2, WxD2, WyB, WyC2, WyD2, WyE.	Good if slope is 0 to 6 percent, fair if 6 to 12 percent, poor if more than 12 percent; hazard of water erosion.	Good if slope is 0 to 12 percent, fair if 12 to 20 percent, poor if more than 20 percent.	Good if slope is 0 to 20 percent, fair if more than 20 percent.
Group 2: Well drained to moderately well drained soils that have a clayey subsoil. Briggsville: BsB, BtB2.	Good if slope is 0 to 6 percent, fair if more than 6 percent; hazard of water erosion.	Good----------	Good----------
Group 3: Excessively drained to moderately well drained soils that are sandy throughout or have a sandy surface layer and soils that have a shallow root zone. Boone: BnC, BnE. Boyer: BpA, BpB, BpC2, BpD2. Channahon: CaB, CaC2, CaE2. Chelsea: ChB, ChC. Lorenzo: LoB, LoC2, LoD2. Northfield: NoB, NoC, NoE. Okee: OkB, OkC. Oshtemo: OmA, OmB, OmC2, OmD2.	Poor or fair if slope is 0 to 6 percent, poor if more than 6 percent; droughty soil; hazard of soil blowing.	Fair if slope is 0 to 12 percent, poor if more than 12 percent; droughty soil; some species not suited.	Fair if slope is 0 to 20 percent, poor if more than 20 percent; droughty soil; some species not suited.

vine planting guide—Continued

Growth characteristics					Esthetic value		
Ground cover	Potential height	Type of plant	Thorny	Thicket forming	Flowers	Fruit or berries	Fall color
----------	7–9	Shrub-------	----------	----------	x	x	x
----------	3–5	Shrub-------	----------	----------	x	x	x
----------	9–12	Shrub-------	----------	----------	x	x	x
----------	8–10	Shrub-------	----------	----------	x	x	x
----------	2–8	Shrub-------	----------	----------	----------	----------	----------
----------	6–9	Shrub-------	----------	----------	----------	x	x

of wildlife habitat

Woody plants		Wetland plants for food and cover	Shallow and deep water developments
Hardwood trees and shrubs	Coniferous trees		
Good if slope is 0 to 20 percent, fair if more than 20 percent.	Good if slope is 0 to 20 percent, fair if more than 20 percent.	Poor if slope is 0 to 2 percent, very poor if more than 2 percent; few species suited.	Poor if slope is 0 to 2 percent, very poor if more than 2 percent; dominantly moderate permeability in substratum.
Good----------	Good----------	Poor if slope is 0 to 2 percent, very poor if more than 2 percent; few species suited.	Fair if slope is 0 to 2 percent, poor if more than 2 percent; moderately slow permeability in substratum.
Fair if slope is 0 to 20 percent, poor if more than 20 percent; droughty soil; some species not suited.	Fair if slope is 0 to 20 percent, poor if more than 20 percent; droughty soil; some species not suited.	Very poor: droughty soil-----	Very poor: moderately rapid or rapid permeability in subsoil; shallow over very porous substratum or bedrock.

TABLE 6.—*Soils and elements*

Wildlife group, description of soils, soil series, and map symbols	Grain and seed crops	Grasses and legumes	Wild herbaceous plants
Plainfield: PeC2, PfA, PfB, PfC, PfD, PkB, PkC, PkD. Puchyan: PuB, PuC. Sparta: SpB. Tustin: TuB. Wyocena: WoB, WoC2, WoD2, WoE.			
Group 4: Well drained to moderately well drained soils that have a thick, dark-colored surface layer and are loamy throughout. Friesland: FrB. Griswold: GrB2, GrC2, GrD2. Plano: PnA, PnB, PnC2. Ringwood: RdB2, RdC2. Ripon: ReB, ReC2. Rotamer: RtB, RtC2, RtD2, RtE2. Salter, variant: ScB. Saybrook: SeB2, SeC2, SeD2. Troxel: TsA.	Good if slope is 0 to 6 percent, fair if 6 to 12 percent, poor if more than 12 percent; hazard of water erosion.	Good if slope is 0 to 12 percent, fair if 12 to 20 percent, poor if more than 20 percent.	Good if slope is 0 to 20 percent, fair if more than 20 percent.
Group 5a: Somewhat poorly drained soils. Atterberry: AtA, AtB. Grellton, variant: GnA. Joy: JoA. Kibbie: KbA. Marcellon: MaB. Morocco: MoA. Tustin, variant: TvA. Wasepi: WcA. Yahara: YaA.	Good if drained; fair if undrained and wet.	Good if drained, fair if undrained and wet; some species not suited.	Fair: wet; some species not suited.
Group 5b: Poorly drained and very poorly drained mineral soils and land types. Alluvial land, sandy, wet: Af. Alluvial land, loamy, wet: Ah. Barry: BbA. Colwood: CoA. Gilford: GaA. Granby: Gb. Marshan: Mc. Ossian: OsA. Otter: Ot. Poygan: PoA. Wacousta: Wa. Wallkill: Wb.	Good if drained, very poor if undrained and wet.	Fair if drained, poor if undrained and wet; some species not suited.	Poor: very wet; few species suited.
Group 6: Very poorly drained organic soils and Marsh. Adrian: Ad. Boots: Bo. Houghton: Ho. Marsh: Mb. Palms: Pa.	Fair if drained, very poor if undrained and wet.	Fair if drained, very poor if undrained and wet; few species suited.	Poor: very wet; few species suited.
Group 7: Moderately well drained to somewhat poorly drained land types that are subject to flooding. Alluvial land, sandy: Ae. Alluvial land, loamy: Ag.	Good if drained, fair if undrained and seasonally wet; hazard of flooding.	Good if drained, fair if undrained and seasonally wet; hazard of flooding; some species not suited.	Fair: seasonally wet; hazard of flooding; some species not suited.
Group 8: Thin, droughty, or stony and rocky land types and very shallow soils. Rock land: Rk. Rodman: RoC, RoD, RoE. Sandy land: Sd.	Poor: hazard of water erosion; shallow root zone; droughty soil.	Poor: shallow root zone; droughty; few species suited.	Fair if slope is 0 to 20 percent, poor if more than 20 percent; shallow root zone; droughty; some species not suited.

of wildlife habitat

Woody plants		Wetland plants for food and cover	Shallow and deep water developments
Hardwood trees and shrubs	Coniferous trees		
Fair if slope is 0 to 20 percent, poor if more than 20 percent; grass competition.	Fair if slope is 0 to 20 percent, poor if more than 20 percent; grass competition.	Poor if slope is 0 to 2 percent, very poor if more than 2 percent; few species suited.	Poor if slope is 0 to 2 percent, very poor if more than 2 percent; most soils in the group have moderately permeable subsoils.
Good: wet; some species not suited.	Fair: wet; some species not suited.	Fair: wet; some species not suited.	Good if slope is 0 to 2 percent, fair if more than 2 percent; wet soil; mostly moderately permeable subsoils.
Fair: very wet; few species suited.	Poor: very wet; few species suited.	Good	Good.
Poor: very wet: few species suited. Very poor for Marsh.	Fair: very wet; some species not suited. Very poor for Marsh.	Good	Good.
Good: seasonally wet; hazard of flooding; some species not suited.	Fair: seasonally wet; hazard of flooding; some species not suited.	Fair: seasonally wet; some species not suited.	Poor: seasonally wet; moderate or rapid permeability.
Poor: droughty; shallow root zone; few species suited.	Poor: droughty; shallow root zone; few species suited.	Very poor: droughty	Very poor: rapidly permeable or shallow over bedrock.

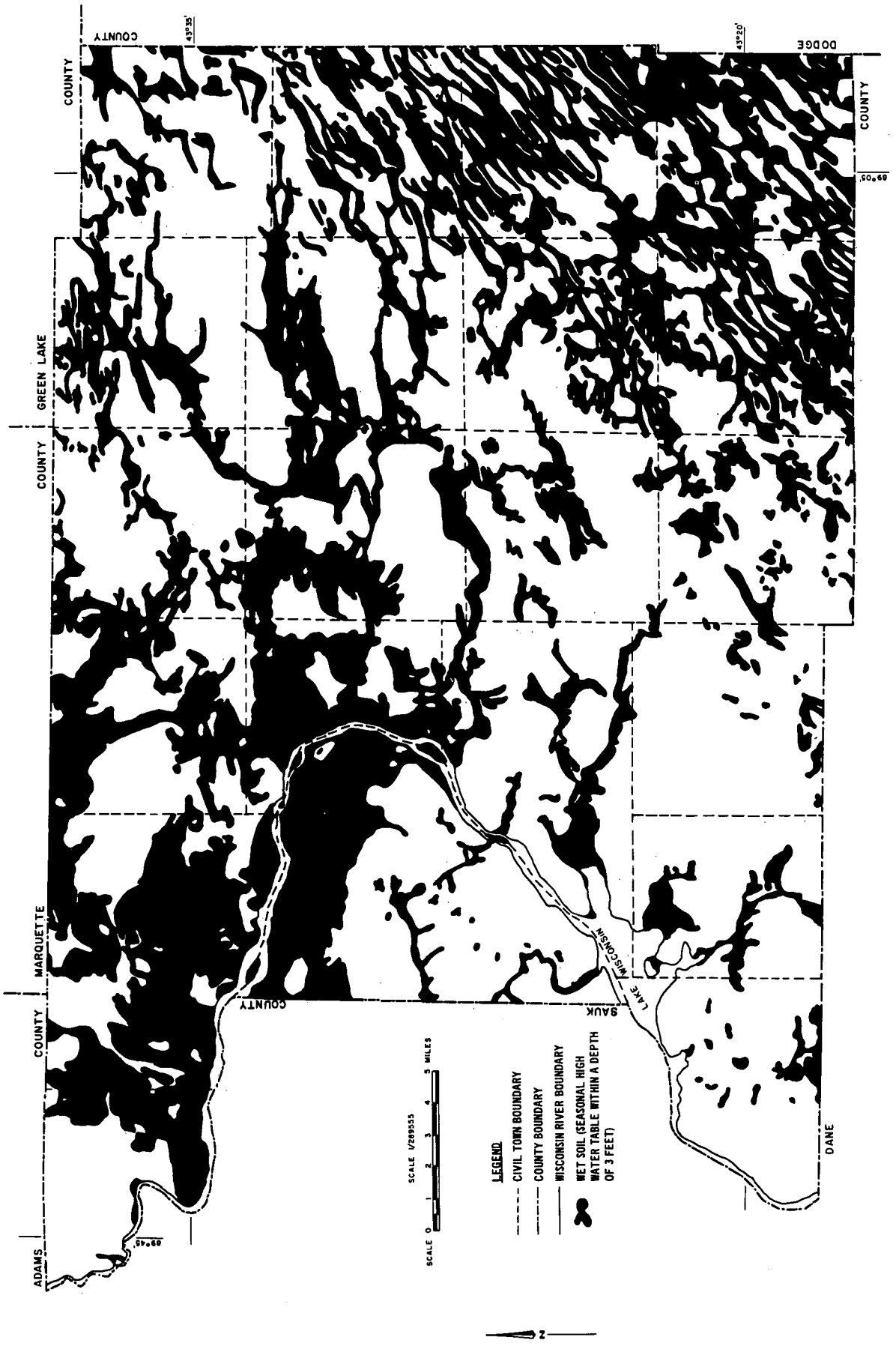

Figure 21.—Distribution of wet soils in Columbia County. Soils have a seasonal high water table within a depth of 3 feet, or are subject to flooding, or both.

Wetland plants for food and cover are forbs, grasses, sedges, aquatic plants, and woody plants that grow well in wet areas. They furnish fruit, seeds, browse, and cover for wildlife that live in wet areas and on or near open water. Examples are smartweed, canarygrass, sedges, and sagittaria. These plants grow well in Type 1, 2, and 6 wetlands as defined in U.S. Department of the Interior Circular 39 *(15)*. Type 1 wetlands are seasonally flooded basins and nearly level areas that are covered or saturated with water during seasonally wet periods but are dry during much of the growing season. Type 2 wetlands are fresh meadows that are not covered by water during the growing season but are saturated within a few inches of the soil surface. Type 6 wetlands consist of shrub swamp areas in which the soil is saturated during the growing season and is often covered with as much as 6 inches of water.

Shallow water areas are less than 5 feet deep. They are natural and dugout water areas or water areas formed by a combination of dugout areas and low embankments. Common plants are cattails, bulrushes, sedges, and reeds. These are Type 3 and 4 wetlands, as defined by the U.S. Department of the Interior. Type 3 wetlands consist of shallow marshes in which the soil is saturated or covered with as much as 6 inches of water during the growing season. Type 4 wetlands are defined as deep marshes that are covered by 6 inches to about 3 feet of water during the growing season.

Deep water areas, more than 5 feet deep, consist of natural water areas, dugout areas, or water areas formed by a combination of dugout areas and embankments. Common plants are coontail, water lilies, milfoil, and waterweed. The deep water areas consist of ponds, lakes, and Type 5 wetlands as defined by the U.S. Department of the Interior. Type 5 wetlands are open freshwater areas, such as shallow ponds and reservoirs or areas where water is less than 10 feet deep.

The levels of suitability in table 6 are expressed as good, fair, poor, or very poor. *Good* indicates that the habitat is easily improved, maintained, or created. There are few or no soil limitations in habitat management, and satisfactory results can be expected. *Fair* indicates that the habitat can be improved, maintained, or created on these soils, but moderate soil limitations affect habitat management or development. A moderate intensity of management and fairly frequent attention may be required to insure satisfactory results. *Poor* indicates that the habitat can be improved, maintained, or created on these soils, but soil limitations are severe. Habitat management can be difficult and expensive and requires intensive effort. Results are questionable. *Very poor* indicates that under the prevailing soil conditions, it is impractical to attempt to improve, maintain, or create habitat. Unsatisfactory results are probable.

Table 7 lists the important kinds of wildlife in Columbia County and rates the importance of the various habitat elements for the stated kinds of wildlife.

Using tables 6 and 7, the suitability of a particular soil for a given species of wildlife can be determined. For example, critical parts of the habitat for ringnecked pheasants are grass and legumes, wild herbaceous upland plants, and herbaceous wetland plants. Only a combination of soil groups would be well suited to all these habitat elements. An environment containing soils in Group 1 and Group 6 would be desirable.

Soils and Recreation

Recreation is of considerable importance in Columbia County. The local population has remained fairly stable, but the attraction of the Wisconsin Dells area greatly increases the summer population. In addition, the Interstate Highway system provides easy access to the area from concentrations of population in the Madison, Milwaukee, and Chicago areas. A large number of facilities are needed to accommodate the summer influx of people.

Columbia County has a fair supply of surface water. Approximately 4.5 percent of the county is covered by water. This 23,219 acres consists of about 56 lakes, 369 acres of streams, and the Wisconsin, Baraboo, Crawfish, and Fox Rivers. These rivers and lakes provide the county with 742 miles of river frontage and 124 miles of lake frontage, but recreational development potential is largely confined to the few larger lakes, such as Lake Wisconsin, and to the streams and rivers. Some of the smaller lakes can be used for swimming and fishing. The river and lake frontage is the site of many cottages, summer homes, and many of the dozen or so campgrounds in the county. Activities on these waters are boating, swimming, fishing, and sightseeing in warm weather and skating, ice boating, ice fishing, and snowmobiling in cold weather.

According to a 1968 recreation plan for Columbia County, more public facilities will be needed in the near future for group camping, picnicking, swimming, and canoeing. The county has no State parks, but the State Game Farm just east of Poynette provides picnic facilities and attracts many tourists. The State of Wisconsin also owns more than 7,000 acres of public hunting grounds in the county that are available for hunting, fishing, hiking, nature study, and riding. In addition, many county and local parks provide recreational facilities, such as playgrounds and picnic areas. Many private enterprises also supply recreational facilities in the county, such as those for camping, picnicking, pond fishing, golfing, boating, hunting, and riding.

Because a large acreage is already used for recreational purposes, and this acreage is increasing, an understanding of soil properties and limitations is important. Among these soil properties are wetness, texture, permeability, slope, depth to bedrock, susceptibility to erosion and flooding, coarse fragments on the surface, stoniness, and rockiness.

Recreation groups

To help in planning the management of areas used for recreation, the soils of Columbia County have been assigned to eight recreation groups. Each group is made up of soils that have similar limitations affecting their use and that require similar management. Limitations are expressed as slight, moderate, or severe. Table 8 shows the degree and kind of soil limitations for

TABLE 7.—*Value of selected elements of wildlife habitat*

[Numeral 1 indicates little or no value; 2, some value; 3, important; 4, very important. Asterisk indicates a key or critical element to the survival of the stated kind of wildlife. Dashes mean not applicable]

Wildlife species	Grain and seed crops		Grasses and legumes		Wild herbaceous plants	Woody plants			Wetland plants for food and cover	Water areas	
						Hardwood		Coniferous trees			
	Harvested	Unharvested	Harvested	Unharvested		Shrubs	Trees			Shallow water	Deep water
Migratory waterfowl:											
Ducks	3	3	1	3	3	-------	1	-------	*4	*4	4
Geese	4	*4	4	1	-------	-------	-------	-------	2	3	3
Upland game birds:											
Hungarian partridge	4	4	3	4	4	1	-------	-------	1	-------	-------
Pheasant	4	4	-------	*4	*4	4	-------	1	*4	3	-------
Quail	4	4	2	4	4	*4	2	1	4	3	-------
Woodcock	------	-------	1	3	3	4	4	2	3	-------	-------
Small game:											
Rabbits, cottontail	3	4	3	*4	*4	*4	3	1	2	3	-------
Racoon	3	4	-------	1	1	2	4	-------	1	*4	4
Squirrels, fox and gray	3	4	-------	1	1	2	*4	1	-------	-------	-------
Big game:											
Deer	3	4	3	3	4	4	4	4	3	3	2
Furbearers:											
Beaver	------	-------	-------	-------	-------	4	*4	-------	4	4	*4
Fox, red [1]	2	3	2	3	3	3	2	1	3	3	1
Mink [1]	------	-------	-------	-------	-------	2	1	1	3	*4	*4
Muskrat	1	1	-------	-------	-------	1	-------	-------	4	*4	*4

[1] Carnivorous species not strictly dependent on elements listed.

TABLE 8.—*Degree and kind of limitations for recreational uses*

Recreation groups, descriptions of soils, soil series, and map symbols	Camp areas [1]	Picnic areas	Playgrounds [1]	Paths and trails
Group 1: Moderately well drained and well drained silty soils. Baraboo: BaB2, BaC2, BaD, BaE. Briggsville: BtB2. Channahon: CaB, CaC2, CaE2. Dodge: DoB2, DoC2, DoD2. Griswold: GrB2, GrC2, GrD2. Knowles: KnB, KnC2, KnD2. McHenry: MeB2, MeC2, MeD2. Mt. Carroll: MrD2, MtA, MtB, MtC2. Plano: PnA, PnB, PnC2. Ringwood: RdB2, RdC2. Ripon: ReB, ReC2. St. Charles: SaA, SaB2, SaC2, SaD2, SaE. Saybrook: SeB2, SeC2, SeD2. Seaton: SfA, SfB2, SfC2, SfD2. Troxel: TsA.[2]	Moderate if slope is 0 to 12 percent, severe if more than 12 percent; erodible on slopes; compacts easily; wet and soft after rain.	Slight if slope is 0 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent; erodible on slopes; compacts easily when wet.	Moderate if slope is 0 to 6 percent, severe if more than 6 percent; erodible on slopes; compacts easily when wet.	Moderate if slope is 0 to 12 percent, severe if more than 12 percent; erodible on slopes; muddy and slippery when wet.

TABLE 8.—*Degree and kind of limitations for recreational uses—Continued*

Recreation groups, descriptions of soils, soil series, and map symbols	Camp areas [1]	Picnic areas	Playgrounds [1]	Paths and trails
Group 2: Moderately well drained and well drained loamy soils. Boyer: BrA, BrB. Briggsville: BsB. Dresden: DrB, DrC2, DrD2. Friesland: FrB. Grellton: GeB, GeC2. Lapeer: LaB, LaC2, LaD2, LaE2. Lorenzo: LoB, LoC2, LoD2. Military: MnB, MnC2, MnD2. Northfield: NoB, NoC, NoE. Rotamer: RtB, RtC2, RtD2, RtE2. Salter: SbA, SbB, SbC2, SbD2, ScB. Sisson: SnA, SnB, SnC2, SnD2, SnE. Winneshiek: WnB, WnC2. Wyocena: WxB, WxC2, WxD2, WyB, WyC2, WyD2, WyE.	Slight if slope is 0 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent; erodible on slopes.	Slight if slope is 0 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent; erodible on slopes.	Slight if slope is 0 to 2 percent, moderate if 2 to 6 percent, severe if more than 6 percent; erodible on slopes.	Slight if slope is 0 to 12 percent, moderate if 12 to 20 percent, severe if more than 20 percent; erodible on slopes.
Group 3: Moderately well drained to excessively drained sandy soils. Boone: BnC, BnE. Boyer: BpA, BpB, BpC2, BpD2. Chelsea: ChB, ChC. Okee: OkB, OkC. Oshtemo: OmA, OmB, OmC2, OmD2. Plainfield: PfA, PfB, PfC, PfD, PkB, PkC, PkD. Puchyan: PuB, PuC. Sparta: SpB. Tustin: TuB. Wyocena: WoB, WoC2, WoD2, WoE.	Moderate if slope is 0 to 6 percent, severe if more than 6 percent; droughty; vegetation difficult to maintain; erodible.	Moderate if slope is 0 to 6 percent, severe if more than 6 percent; droughty; difficult to maintain a good sod; erodible.	Moderate if slope is 0 to 2 percent, severe if more than 2 percent; droughty; difficult to maintain a good sod; erodible; leveling exposes loose sand.	Moderate if slope is 0 to 12 percent, severe if more than 12 percent; droughty; poor stability on slopes; erodible; difficult to maintain.
Group 4: Somewhat poorly drained soils. Atterberry: AtA, AtB. Grellton, variant: GnA. Joy: JoA. Kibbie: KbA. Marcellon: MaB. Morocco: MoA. Tustin, variant: TvA. Wasepi: WcA. Yahara: YaA.	Moderate: wet and soft for moderate periods; water ponds for short periods in places.	Moderate: wet for moderate periods; sod easily damaged when wet; water ponds for short periods in places.	Moderate: wet for moderate periods; sod easily damaged when wet; water ponds for short periods in places.	Moderate: wet for moderate periods; muddy and slippery when wet.
Group 5: Poorly drained and very poorly drained soils. Barry: BbA. Colwood: CoA. Gilford: GaA. Granby: Gb. Marshan: Mc. Ossian: OsA. Poygan: PoA. Wacousta: Wa.	Severe: wet and soft for long periods; poor trafficability; water ponds for long periods.	Severe: wet for long periods; sod is easily damaged; water ponds for long periods; poor trafficability.	Severe: wet for long periods; sod is easily damaged; water ponds for long periods; poor trafficability.	Severe: wet for long periods; muddy and slippery when wet; poor trafficability.
Group 6: Soils and land types that are subject to flooding. Alluvial land, sandy: Ae. Alluvial land, sandy, wet: Af. Alluvial land, loamy: Ag. Alluvial land, loamy, wet: Ah. Otter: Ot. Wallkill: Wb.	Severe: occasional or frequent flooding; wet for long or short periods; sod is easily damaged when wet.	Severe: occasional or frequent flooding; wet for long or short periods; sod is easily damaged when wet.	Severe: occasional or frequent flooding; wet for long or short periods; sod is easily damaged when wet.	Severe: occasional or frequent flooding; wet for long or short periods; muddy and slippery when wet.

TABLE 8.—*Degree and kind of limitations for recreational uses—Continued*

Recreation groups, descriptions of soils, soil series, and map symbols	Camp areas [1]	Picnic areas	Playgrounds [1]	Paths and trails
Group 7: Organic soils. Adrian: Ad. Boots: Bo. Houghton: Ho. Palms: Pa.	Severe: wet and soft for long periods; poor trafficability; water ponds for short periods in places.	Severe: wet for long periods; sod is easily damaged; poor trafficability; water ponds for short periods in places.	Severe: wet for long periods; sod is easily damaged; poor trafficability; water ponds for short periods in places.	Severe: wet for long periods; poor trafficability; difficult to maintain.
Group 8: Land types and gravelly or very sandy soils. Marsh: Mb. Plainfield: PeC2. Rock land: Rk. Rodman: RoC, RoD, RoE. Sandy land: Sd.	Severe: very steep; flooded most of the year; gravelly; lacks vegetative cover in places.	Severe: very steep; flooded most of the year; gravelly; lacks vegetative cover in places.	Severe: very steep; flooded most of the year; gravelly; lacks vegetative cover in places.	Severe: very steep; flooded most of the year; gravelly; poor stability on slopes; difficult to maintain.

[1] Extensive leveling is likely to expose sand and gravel or bedrock, especially in shallow soils such as Channahon, Lorenzo, and Northfield soils.
[2] Subject to overwash; severe limitation for camp areas.

specified uses. The ratings are only general. Onsite investigation is needed if development of a recreational facility is planned.

A limitation of *slight* means that soil properties are generally favorable and limitations are so minor that they easily can be overcome. A *moderate* limitation can be overcome or modified by planning, by design, or by special maintenance. A *severe* limitation means that costly soil reclamation, special design, intense maintenance, or a combination of these, is required.

Camp areas are used intensively for tents and small camp trailers and the accompanying activities of outdoor living. Little preparation of the site is required, other than shaping and leveling for tent and parking areas. Camp areas are subject to heavy foot traffic and limited vehicular traffic. The best soils have mild slopes, good drainage, a surface free of rocks and coarse fragments, freedom from flooding during periods of heavy use, and a surface that is firm after rains but not dusty when dry.

Playgrounds are areas used intensively for baseball, football, badminton, and similar organized games. Soils suitable for this use need to withstand intensive foot traffic. The best soils have a nearly level surface free of coarse fragments and rock outcrops, good drainage, freedom from flooding during periods of heavy use, and a surface that is firm after rains but not dusty when dry. If grading and leveling are required, depth to rock is important.

Picnic areas are attractive natural or landscaped tracts used mainly for preparing and eating meals outdoors. These areas are subject to heavy foot traffic. Most of the vehicular traffic, however, is confined to access roads. The best soils are firm when wet but not dusty when dry, are free of flooding during the season of use, and do not have slopes or stoniness that greatly increases cost of leveling sites or of building access roads.

Paths and trails are used for local and cross-country travel by foot or horseback. Design and layout should require little or no cutting and filling. The best soils are at least moderately well drained, are firm when wet but not dusty when dry, are flooded not more than once during the season of use, have slopes of less than 15 percent, and have few or no rocks or stones on the surface.

Only the major hazards and limitations are shown in table 8. Esthetic qualities and the size and shape of soil areas were not considered in establishing the ratings. Nevertheless, such features may be important in selecting a site.

The ratings for the poorly drained and very poorly drained soils are for soils in their natural state without adequate drainage. Many of these soils can be improved by artificial drainage.

Soils subject to flooding vary considerably in their degree of limitation for recreational use, depending on the length and duration of flooding and on the season in which flooding occurs. Flooding in a season in which the recreational facility is not used is much less restrictive than flooding in the season of use.

The use of a soil as a site for a cottage, service building, or utility building depends on such soil properties as susceptibility to flooding and frost heave, shrink-swell potential, bearing capacity, depth to bedrock, and wetness. Soils such as Channahon, Knowles, and Winneshiek soils that are underlain by bedrock at a depth of less than 40 inches have severe limitations for buildings with basements. In addition, extensive leveling can expose bedrock. Soils in recreation groups 4, 5, 6, and 7, which are somewhat poorly drained to very poorly drained or soils subject to flooding, are severely limited for septic tank filter fields. Information about properties of the soils that affect their use for septic tank filter fields and as sites for building is described in the section "Engineering Uses of the Soils."

Engineering Uses of the Soils [5]

This section is useful to those who need information about soils used as structural material or as founda-

[5] ROBERT C. RINTZLER and HARRY C. BROWN, engineers, Soil Conservation Service, helped prepare this section.

tions upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among properties of soils highly important in engineering are permeability, strength, compaction characteristics, soil drainage condition, shrink-swell potential, grain size, plasticity, and soil reaction. Also important are depth to the water table, depth to bedrock, and soil slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful to those who—

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance or structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-county movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 9, 10, 11, and 12, which show, respectively, estimates of soil properties significant in engineering; engineering interpretations for nonfarming uses; engineering interpretations for use in farming; and results of engineering laboratory tests on soil samples.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in tables 10 and 11, and it also can be used to make other useful maps.

This information, however, does not eliminate need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths greater than 5 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering. Also, specific values for bearing capability should not be assigned to estimated values expressed in words.

Some of the terms used in this soil survey have special meaning in soil science that may be unfamiliar to engineers. The Glossary defines many of these terms.

Engineering soil classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system *(2)* used by the SCS engineers, Department of Defense, and others, and the AASHTO system adopted by the American Association of State Highway and Transportation Officials *(1)*.

In the Unified system soils are classified according to particle-size distribution, plasticity, liquid limit, and organic matter. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example, ML-CL.

The AASHTO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system, a soil is placed in one of seven basic groups ranging from A-1 through A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils of high bearing strength, or the best soil for subgrade (foundation). At the other extreme, in group A–7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHTO classification for tested soils, with group index numbers in parentheses, is shown in table 12; the estimated classification, without group index numbers, is given in table 9 for all soils mapped in the survey area.

USDA texture is determined by the relative proportions of sand, silt, and clay in soil material that is less than 2.0 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. "Sand," "silt," "clay," and some of the other terms used in the USDA textural classification are defined in the Glossary. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, as for example, "gravelly sandy loam."

Soil properties significant in engineering

In table 9 the soil series and map symbols for each series are listed, and estimates of properties significant are given. The estimates are for undisturbed, representative soil profiles, by layers sufficiently different to have different significance for soil engineering. The estimates are based on data shown in table 12, on comparison with similar soils in adjacent counties that have been tested, and on field observations made in the course of mapping the soils. Following are explanations of some of the columns in table 9.

TABLE 9.—*Estimates of soil*

[Dashes indicate information is not available or

Soil series and map symbols	Depth to—		Depth from surface	Classification		
	Bedrock	Seasonal high water table		Dominant USDA texture	Unified	AASHTO
	Inches	*Feet*	*Inches*			
Adrian: Ad	>60	0–1	0–30	Muck	Pt	
			30–60	Sand	SP	A–3
Alluvial land, sandy: Ae. No valid estimates can be made; material too variable.[2]						
Alluvial land, sandy, wet: Af. No valid estimates can be made; material too variable.[2]						
Alluvial land, loamy: Ag. No valid estimates can be made; material too variable.[2]						
Alluvial land, loamy, wet: Ah. No valid estimates can be made; material too variable.[2]						
Atterberry: AtA, AtB	>60	1–3	0–10	Silt loam	ML	A–4
			10–45	Heavy silt loam	CL	A–6
			45–60	Silt loam	ML	A–4
Baraboo: BaB2, BaC2, BaD, BaE	20–40	3–>5	0–5	Silt loam	ML	A–4
			5–36	Heavy silt loam	CL	A–6
			36	Quartzite.		
Barry: BbA	>60	0–1	0–14	Loam	ML	A–4
			14–35	Gravelly heavy loam	CL	A–6
			35–60	Gravelly sandy loam	SM	A–2
Boone: BnC, BnE	20–40	>5	0–4	Loamy fine sand	SM	A–2
			4–45	Sand	SP–SM	A–3
			45	Sandstone.		
Boots: Bo	>60	0–1	0–60	Muck and peat	Pt	
Boyer: BpA, BpB, BpC2, BpD2, BrA, BrB.	>60	>5	0–7	Loamy sand	SM	A–2
			7–20	Sandy loam	SM	A–2
			20–32	Loamy sand	SM	A–2
			32–60	Sand and gravel	SP	A–3
Briggsville: BsB	>60	3–>5	0–10	Loam	ML	A–4
			10–58	Silty clay	CH	A–7
			58–60	Heavy silty clay loam	CL	A–7
Briggsville, variant: BtB2	>60	3–>5	0–8	Silt loam	ML	A–4
			8–38	Heavy silt loam	CL	A–6
			38–60	Silty clay	CL	A–7
Channahon: CaB, CaC2, CaE2	10–20	>5	0–12	Silt loam	ML	A–4
			12–16	Heavy silt loam	CL	A–6
			16	Limestone.		
Chelsea: ChB, ChC	>60	>5	0–25	Loamy fine sand	SM	A–2
			25–45	Sand	SP–SM	A–3
			45–60	Light sandy loam	SM	A–2
Colwood: CoA	>60	0–1	0–21	Fine sand loam	SM	A–4
			21–37	Loam	CL	A–6
			37–60	Silt loam, loam, and sand	ML	A–4
Dodge: DoB2, DoC2, DoD2	>60	>5	0–8	Silt loam	ML	A–4
			8–30	Heavy silt loam	CL	A–6
			30–39	Sandy clay loam	SC	A–4 or A–6
			39–60	Sandy loam	SM	A–2

properties significant in engineering

does not apply. The symbol > means more than]

Percentage passing sieve—			Permeability	Available water capacity	Reaction [1]	Shrink-swell potential	Risk of corrosion to—	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 200 (0.074 mm)					Uncoated steel	Concrete
			Inches per hour	*Inches per inch of soil*	*pH*			
---	---	---	2.0–6.0	0.30–0.35	5.6–7.3	---	Moderate	Moderate.
100	100	1–3	6.0–20.0	0.04–0.06	6.1–7.8	Low	Moderate	Low.
100	100	85–95	0.6–2.0	0.20–0.22	6.1–7.8	---	---	
100	100	85–95	0.2–2.0	0.10–0.21	5.6–7.8	Moderate	High	Low.
100	100	85–95	0.2–0.6	0.20–0.22	6.6–8.4	Low	Moderate	Low.
100	100	85–95	0.6–2.0	0.20–0.22	6.1–7.3	---	---	
100	100	85–95	0.6–2.0	0.19–0.21	5.6–6.5	Moderate	Moderate	Moderate.
95–100	90–100	50–60	0.6–2.0	0.20–0.22	6.1–7.3	---	---	
85–90	80–85	45–55	0.6–2.0	0.13–0.15	6.1–7.8	Moderate	High	Low.
80–85	75–80	25–30	2.0–6.0	0.07–0.09	7.4–8.4	Low	Moderate	Low.
100	100	15–20	6.0–20.0	0.11–0.13	5.1–6.5	---	---	
100	100	6–10	6.0–20.0	0.05–0.07	5.1–6.5	Low	Low	High.
---	---	---	2.0–6.0	0.30–0.35	5.6–7.3	---	Moderate	Low.
95–100	90–100	15–20	6.0–20.0	0.09–0.11	6.1–7.3	---	---	
85–95	80–90	25–35	2.0–6.0	0.10–0.12	5.6–7.3	Low	Low	Low.
85–90	75–85	15–20	6.0–20.0	0.07–0.09	[2] 5.6–7.3	Low	Low	Low.
85–95	80–85	1–3	6.0–20.0	(4)	7.4–8.4	Low	Low	Low.
95–100	90–100	55–65	0.6–2.0	0.20–0.22	6.1–7.3	---	---	
100	100	90–95	0.2–0.6	0.14–0.16	[2] 5.6–6.5	High	High	Moderate.
100	100	85–95	0.2–0.6	0.17–0.19	7.4–8.4	High	High	Low.
100	100	85–90	0.6–2.0	0.20–0.22	6.1–7.3	---	---	
100	100	85–90	0.6–2.0	0.19–0.21	5.6–6.5	Low	Low	Low.
100	100	90–95	0.2–0.6	0.14–0.16	[3] 5.6–6.5	High	High	Low.
100	90–95	85–90	0.6–2.0	0.20–0.22	6.1–8.4	---	---	
85–95	90–95	70–80	0.6–2.0	0.19–0.21	6.1–8.4	Low	Low	Low.
100	100	20–25	6.0–20.0	0.11–0.13	5.6–7.3	Low	Low	Low.
100	100	6–10	6.0–20.0	0.05–0.07	5.6–7.3	Low	Low	Low.
100	100	25–35	2.0–6.0	0.09–0.11	6.1–7.3	Low	Low	Low.
100	95–100	35–45	0.6–2.0	0.14–0.16	5.6–7.3	---	---	
100	95–100	55–65	0.6–2.0	0.18–0.20	6.1–7.3	Moderate	High	Low.
100	95–100	65–75	0.6–2.0	0.14–0.16	6.1–8.4	Low	Moderate	Low.
100	100	85–95	0.6–2.0	0.22–0.24	6.1–7.3	---	---	
100	100	90–95	0.6–2.0	0.19–0.21	5.6–6.5	Moderate	Moderate	Moderate.
95–100	90–95	30–40	0.6–6.0	0.14–0.16	[3] 6.1–7.3	Low	Moderate	Low.
85–90	80–90	20–30	2.0–6.0	0.10–0.12	7.4–8.4	Low	Low	Low.

TABLE 9.—*Estimates of soil*

Soil series and map symbols	Depth to—		Depth from surface	Classification		
	Bedrock	Seasonal high water table		Dominant USDA texture	Unified	AASHTO
	Inches	*Feet*	*Inches*			
Dresden: DrB, DrC2, DrD2	>60	>5	0–8	Loam	ML	A–4
			8–26	Sandy clay loam	SC	A–6
			26–60	Sand and gravel	GP	A–1
Friesland: FrB	>60	3–>5	0–19	Fine sandy loam	SM	A–4
			19–35	Heavy loam	CL	A–6
			35–45	Heavy silt loam	CL	A–6
			45–60	Silt loam	ML	A–4
Gilford, stratified substratum: GeA.	>60	0–1	0–14	Fine sandy loam	SM	A–4
			14–32	Fine sandy loam	SM	A–4
			32–60	Sand and silt	SM or ML	A–4
Granby: Gb	>60	0–1	0–16	Loamy sand	SP–SM or SM	A–2
			16–60	Sand	SP	A–3
Grellton: GeB, GeC2	>60	3–>5	0–5	Fine sandy loam	SM	A–4
			5–23	Heavy loam	CL	A–6
			23–55	Heavy silt loam	CL	A–6
			55–60	Sandy loam	SM	A–2
Grellton, variant: GnA	>60	1–3	0–9	Fine sandy loam	SM	A–4
			9–25	Loam	CL	A–6
			25–50	Silty clay loam	CL	A–6
			50–60	Silt loam	ML	A–4
Griswold: GrB2, GrC2, GrD2	>60	>5	0–13	Silt loam	ML	A–4
			13–38	Sandy clay loam	SC	A–6
			38–60	Sandy loam	SM	A–2
Houghton: Ho	>60	0–1	0–60	Muck	Pt	----------
Joy: JoA	>60	1–3	0–21	Silt loam	ML	A–4
			21–46	Heavy silt loam	CL	A–6
			46–60	Silt loam	ML	A–4
Kibbie: KbA	>60	1–3	0–8	Fine sandy loam	SM	A–4
			8–25	Heavy loam	CL	A–6
			25–60	Silt and sand	ML	A–4
Knowles: KnB, KnC2, KnD2	20–40	>5	0–12	Silt loam	ML	A–4
			12–29	Silty clay loam	CL	A–6
			29–39	Clay loam	CL	A–6
			39	Limestone.		
Lapeer: LaB, LaC2, LaD2, LaE2	>60	>5	0–6	Fine sandy loam	SM	A–4
			6–31	Heavy sandy loam	SC	A–6
			31–60	Gravelly sandy loam	SM	A–2
Lorenzo: LoB, LoC2, LoD2	>60	>5	0–8	Loam	ML	A–4
			8–18	Sandy clay loam	SC	A–6
			18–60	Sand and gravel	GP	A–1
Marcellon: MaB	>60	1–3	0–18	Loam	ML	A–4
			18–36	Heavy loam	CL	A–6
			36–60	Fine sandy loam	SM	A–4
Marsh: Mb. No valid estimates can be made; material too variable.						
Marshan: Mc [2]	>60	0–1	0–10	Loam	ML	A–4
			10–24	Sandy clay loam	SC	A–6
			24–60	Sand	SP	A–3
McHenry: MeB2, MeC2, MeD2	>60	>5	0–8	Silt loam	ML	A–4
			8–19	Light silty clay loam	CL	A–6
			19–37	Sandy clay loam	SC	A–6
			37–60	Gravelly sandy loam	SM	A–2

properties significant in engineering—Continued

Percentage passing sieve—			Permeability	Available water capacity	Reaction [1]	Shrink-swell potential	Risk of corrosion to—	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 200 (0.074 mm)					Uncoated steel	Concrete
			Inches per hour	*Inches per inch of soil*	*pH*			
85–95	80–85	55–65	0.6–2.0	0.20–0.22	6.1–7.3			
80–90	75–80	35–45	0.6–2.0	0.16–0.18	[3] 5.6–7.3	Moderate	Moderate	Low.
40–50	35–40	1–3	>6.0	([4])	7.4–8.4	Low	Low	Low.
100	95–100	35–45	0.6–2.0	0.16–0.18	6.1–7.3			
100	95–100	65–75	0.6–2.0	0.18–0.20	5.6–6.5	Moderate	Low	Moderate.
100	100	80–90	0.6–2.0	0.19–0.21	5.6–6.5	Moderate	Moderate	Moderate.
100	100	85–95	0.6–2.0	0.20–0.22	6.1–7.8	Low	Moderate	Low.
100	95–100	35–45	0.6–2.0	0.16–0.18	6.1–7.8			
100	95–100	35–45	0.6–2.0	0.14–0.16	6.1–7.8	Low	High	Low.
100	95–100	40–50	0.6–2.0	0.14–0.16	6.1–8.4	Low	Moderate	Low.
100	95–100	10–15	6.0–20.0	0.09–0.11	5.6–7.3	Low.		
100	95–100	1–3	6.0–20.0	0.04–0.06	5.6–7.3	Low	Moderate	Low.
100	95–100	35–45	0.6–2.0	0.16–0.18	6.1–7.3			
100	95–100	60–70	0.6–2.0	0.18–0.20	5.6–6.5	Moderate	Low	Low.
100	100	85–95	0.6–2.0	0.19–0.21	[3] 5.6–6.5	Moderate	Moderate	Moderate.
85–90	80–85	20–30	2.0–6.0	0.10–0.12	7.4–8.4	Low	Moderate	Low.
100	95–100	35–45	0.6–2.0	0.16–0.18	6.1–7.3			
100	95–100	50–60	0.6–2.0	0.18–0.20	5.6–6.5	Low	High	Low.
100	100	85–95	0.6–2.0	0.18–0.20	5.6–7.3	Moderate	High	Low.
100	100	85–95	0.6–2.0	0.20–0.22	5.6–7.8	Low	Moderate	Low.
100	95–100	85–95	0.6–2.0	0.22–0.24	6.1–7.3			
95–100	90–95	35–45	0.6–2.0	0.16–0.18	[3] 5.6–7.3	Moderate	Moderate	Low.
85–90	80–85	25–30	2.0–6.0	0.10–0.12	7.4–8.4	Low	Low	Low.
			2.0–6.0	0.30–0.35	5.6–7.3		Moderate	Low.
100	100	85–95	0.6–2.0	0.22–0.24	5.6–7.3			
100	100	85–95	0.6–2.0	0.19–0.21	5.6–7.3	Moderate	High	Low.
100	100	85–95	0.6–2.0	0.20–0.22	6.6–8.4	Low	Moderate	Low.
100	95–100	35–45	0.6–2.0	0.16–0.18	5.6–7.3			
100	95–100	60–70	0.6–2.0	0.18–0.20	5.6–7.3	Moderate	High	Low.
100	95–100	65–75	0.6–2.0	0.14–0.16	6.1–8.4	Low	High	Low.
100	100	85–95	0.6–2.0	0.22–0.24	6.1–7.3			
100	100	85–95	0.6–2.0	0.18–0.20	5.6–6.5	Moderate	Moderate	Moderate.
90–95	80–90	50–60	0.6–6.0	0.16–0.18	6.1–7.8	Low	Moderate	Low.
90–95	85–90	35–45	0.6–2.0	0.16–0.18	6.1–7.3			
90–95	85–90	40–50	0.6–2.0	0.15–0.17	[3] 5.6–6.5	Low	Low	Moderate.
70–80	65–75	25–35	2.0–6.0	0.07–0.09	7.4–8.4	Low	Low	Low.
90–95	80–85	55–60	0.6–2.0	0.20–0.22	6.1–7.3			
85–90	70–80	45–50	0.6–2.0	0.18–0.20	[3] 5.6–7.3	Moderate	Moderate	Low.
40–45	40–45	1–3	>6.0	([4])	7.4–8.4	Low	Low	Low.
95–100	90–100	60–70	0.6–2.0	0.20–0.22	6.1–7.3			
95–100	90–100	65–70	0.6–2.0	0.18–0.20	[3] 5.6–7.3	Moderate	High	Low.
90–100	90–100	35–45	2.0–6.0	0.14–0.16	7.4–8.4	Low	Moderate	Low.
100	100	50–60	0.6–2.0	0.20–0.22	5.6–7.3			
100	100	40–50	0.6–2.0	0.16–0.18	5.6–7.3	Moderate	High	Low.
100	100	2–4	6.0–20.0	([4])	5.6–7.3	Low	Moderate	Low.
100	100	90–95	0.6–2.0	0.22–0.24	6.1–7.3			
100	100	90–95	0.6–2.0	0.19–0.21	5.6–6.5	Moderate	Moderate	Low.
90–95	90–95	35–45	0.6–2.0	0.16–0.18	[3] 6.1–7.3	Moderate	Moderate	Low.
80–85	75–80	25–30	2.0–6.0	0.08–0.10	7.4–8.4	Low	Low	Low.

TABLE 9.—*Estimates of soil*

Soil series and map symbols	Depth to—		Depth from surface	Classification		
	Bedrock	Seasonal high water table		Dominant USDA texture	Unified	AASHTO
	Inches	*Feet*	*Inches*			
Military: MnB, MnC2, MnD2	20–40	>5	0–11	Fine sandy loam	SM	A–4
			11–25	Sandy clay loam	SC	A–6
			25–60	Sandstone.		
Morocco: MoA	>60	1–3	0–9	Loamy sand	SM	A–2
			9–60	Sand	SP–SM	A–3
Mt. Carroll: MrD2, MtA, MtB, MtC2.	>60	3–5	0–12	Silt loam	ML	A–4
			12–48	Heavy silt loam	CL	A–6
			48–60	Silt and sand	ML	A–4
Northfield: NoB, NoC, NoE	10–20	>5	0–4	Sandy loam	SM	A–2
			4–18	Light sandy clay loam	SM or SC	A–2
			18	Sandstone.		
Okee: OkB, OkC	>60	>5	0–24	Loamy fine sand	SP–SM or SM	A–2
			24–34	Sandy clay loam	SC	A–6
			34–60	Gravelly sandy loam	SM	A–2
Oshtemo: OmA, OmB, OmC2, OmD2.	>60	>5	0–7	Loamy sand	SM	A–2
			7–38	Light sandy loam	SM	A–2
			38–46	Loamy sand	SM	A–2
			46–60	Sand and gravel	SP	A–3
Ossian: OsA	>60	0–1	0–18	Silt loam	ML	A–4
			18–33	Light silty clay loam	CL	A–6
			33–60	Silt loam	ML–CL or CL	A–4
Otter: Ot [2]	>60	0–1	0–28	Silt loam	ML–CL or CL	A–4
			28–60	Silty clay loam	CL	A–6
Palms: Pa	>60	0–1	0–30	Muck	Pt	----------
			30–60	Silty clay loam	CL	A–4
Plainfield: PeC2, PfA, PfB, PfC, PfD	>60	>5	0–14	Loamy fine sand	SM	A–2
			14–60	Sand	SP	A–3
PkB, PkC, PkD	>60	>5	0–14	Loamy fine sand	SM	A–2
			14–50	Sand	SP	A–3
			50–60	Sandy loam	SM	A–2
Plano: PnA, PnB, PnC2	>60	3–>5	0–13	Silt loam	ML	A–4
			13–45	Light silty clay loam	CL	A–6
			45–60	Heavy sandy loam	SM–SC or SC	A–4
Poygan: PoA	>60	0–1	0–10	Silt loam	ML	A–4
			10–30	Silty clay	CH	A–7
			30–60	Light silty clay	CL	A–7
Puchyan: PuB, PuC	>60	3–>5	0–25	Loamy fine sand	SM	A–2
			25–58	Silt loam	CL	A–6
			58–60	Silt loam	ML	A–4
Ringwood: RdB2, RdC2	>60	>5	0–13	Silt loam	ML	A–4
			13–23	Light silty clay loam	CL	A–6
			23–32	Sandy clay loam	SC	A–6
			32–60	Sandy loam	SM	A–2
Ripon: ReB, ReC2	20–40	>5	0–13	Silt loam	ML	A–4
			13–30	Silty clay loam	CL	A–6
			30–38	Sandy loam	SM or SC	A–4
			38	Limestone.		
Rock land: Rk. No valid estimates can be made; material too variable.						
Rodman: RoC, RoD, RoE	>60	>5	0–7	Gravelly loam	SM	A–4
			7–60	Gravel and sand	GP	A–1
Rotamer: RtB, RtC2, RtD2, RtE2	>60	>5	0–9	Loam	ML	A–4
			9–15	Heavy sandy loam	SM or SC	A–4
			15–60	Gravelly sandy loam	SM	A–2

properties significant in engineering—Continued

Percentage passing sieve—			Permeability	Available water capacity	Reaction [1]	Shrink-swell potential	Risk of corrosion to—	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 200 (0.074 mm)					Uncoated steel	Concrete
			Inches per hour	*Inches per inch of soil*	*pH*			
100	95–100	35–45	0.6–2.0	0.16–0.18	6.1–7.3			
95–100	90–95	40–45	0.6–2.0	0.16–0.18	5.1–6.5	Low	Moderate	Moderate.
100	95–100	15–20	6.0–20.0	0.09–0.11	5.1–6.0			
100	95–100	5–10	6.0–20.0	0.04–0.06	5.1–6.5	Low	Low	Moderate.
100	100	80–90	0.6–2.0	0.22–0.24	6.1–7.3			
100	100	80–90	0.6–2.0	0.19–0.21	5.6–7.3	Low	Moderate	Low.
100	95–100	75–85	0.2–0.6	0.14–0.16	5.6–8.4	Low	Moderate	Low.
90–95	85–90	25–30	2.0–6.0	0.12–0.14	5.1–6.5			
90–95	85–90	25–35	0.6–2.0	0.14–0.16	5.1–6.5	Low	Low	Moderate.
100	100	15–20	6.0–20.0	0.11–0.13	5.6–7.3	Low	Low	Moderate.
90–95	85–90	35–45	0.6–2.0	0.16–0.18	[3] 5.6–6.5	Moderate	Moderate	Moderate.
70–80	65–75	25–35	2.0–6.0	0.08–0.10	7.4–8.4	Low	Low	Low.
95–100	90–95	15–20	6.0–20.0	0.09–0.11	6.1–7.3			
90–95	85–90	20–25	2.0–6.0	0.11–0.13	5.6–7.3	Low	Low	Moderate.
90–95	80–85	15–20	6.0–20.0	0.07–0.09	[3] 5.6–7.3	Low	Low	Moderate.
95–100	85–90	1–3	6.0–20.0	(4)	7.4–8.4	Low	Low	Low.
100	100	85–95	0.6–2.0	0.22–0.24	6.1–7.8			
100	100	85–95	0.2–2.0	0.19–0.21	6.1–7.8	Moderate	High	Low.
100	100	85–95	0.2–0.6	0.20–0.22	6.6–8.4	Low	Moderate	Low.
100	100	80–90	0.6–2.0	0.22–0.24	6.1–7.8	Low	High	Low.
100	100	85–90	0.6–2.0	0.18–0.20	6.6–8.4	Low	Moderate	Low.
			2.0–6.0	0.30–0.35	5.6–7.3		Moderate	Moderate.
100	100	80–90	0.2–0.6	0.18–0.20	6.1–7.8	Moderate	Moderate	Low.
100	95–100	15–20	6.0–20.0	0.12–0.14	5.6–7.3	Low	Low	Low.
100	95–100	1–3	6.0–20.0	0.04–0.06	5.6–7.3	Low	Low	Low.
100	95–100	15–20	6.0–20.0	0.12–0.14	6.1–7.3	Low	Low	Low.
100	95–100	1–3	6.0–20.0	0.04–0.06	5.6–7.3	Low	Low	Low.
85–90	80–85	25–30	0.6–6.0	0.10–0.12	5.6–8.4	Low	Low	Low.
100	100	85–95	0.6–2.0	0.22–0.24	6.1–7.3			
100	100	85–95	0.6–2.0	0.19–0.21	5.6–6.5	Moderate	Moderate	Moderate.
95–100	90–95	40–50	0.6–6.0	0.13–0.15	[3] 6.1–7.3	Low	Moderate	Low.
100	100	90–95	0.6–2.0	0.22–0.24	6.1–7.3			
100	100	90–95	0.06–0.2	0.14–0.16	6.1–7.8	High	High	Low.
100	100	90–95	0.06–0.2	0.15–0.17	7.4–8.4	High	High	Low.
100	100	15–20	6.0–20.0	0.11–0.13	5.6–7.3	Low	Low	Low.
100	100	80–90	0.6–2.0	0.20–0.22	5.6–7.3	Low	Moderate	Low.
100	100	80–90	0.6–2.0	0.20–0.22	6.6–7.8	Low	Moderate	Low.
100	100	80–90	0.6–2.0	0.22–0.24	6.1–7.3			
100	100	80–90	0.6–2.0	0.19–0.21	5.6–6.5	Moderate	Moderate	Low.
95–100	90–95	40–45	0.6–2.0	0.16–0.18	[3] 6.1–7.3	Moderate	Moderate	Low.
85–90	80–85	25–30	2.0–6.0	0.10–0.12	7.4–8.4	Low	Low	Low.
100	100	90–95	0.6–2.0	0.22–0.24	5.6–7.3			
100	100	90–95	0.6–2.0	0.18–0.20	5.6–6.5	Moderate	Moderate	Moderate.
95–100	90–95	35–45	0.6–6.0	0.12–0.14	6.1–7.8	Low	Moderate	Low.
75–85	70–80	35–40	2.0–6.0	0.15–0.17	6.6–7.8	Low	Low	Low.
35–45	30–40	1–3	>20.0	(4)	7.4–8.4	Low	Low	Low.
90–95	85–90	50–60	0.6–2.0	0.20–0.22	6.1–7.3			
90–95	85–90	35–45	0.6–2.0	0.14–0.16	6.1–7.8	Low	Low	Low.
75–80	70–75	25–30	2.0–6.0	0.08–0.10	7.4–8.4	Low	Low	Low.

TABLE 9.—*Estimates of soil*

Soil series and map symbols	Depth to—		Depth from surface	Classification		
	Bedrock	Seasonal high water table		Dominant USDA texture	Unified	AASHTO
	Inches	*Feet*	*Inches*			
St. Charles: SaA, SaB2, SaC2, SaD2, SaE.	>60	3->5	0–9	Silt loam	ML	A–4
			9–47	Silty clay loam	CL	A–6
			47–58	Sandy clay loam	SM or SC	A–4 or A–6
			58–60	Sandy loam	SM	A–2
Salter: SbA, SbB, SbC2, SbD2	>60	>5	0–8	Fine sandy loam	SM	A–4
			8–39	Fine sandy loam	SM	A–4
			39–60	Stratified sandy loam, loam, and silt.	SM or ML	A–4
Salter, variant: ScB	>60	3->5	0–23	Fine sandy loam	SM	A–4
			23–50	Fine sandy loam	SM	A–4
			50–60	Sand and silt	SM or ML	A–4
Sandy land: Sd. No valid estimates can be made; material too variable.						
Saybrook: SeB2, SeC2, SeD2	>60	>5	0–13	Silt loam	ML	A–4
			13–35	Silty clay loam	CL	A–6
			35–38	Sandy loam	SM	A–2
			38–60	Sandy loam	SM	A–2
Seaton: SfA, SfB2, SfC2, SfD2	>60	>5	0–11	Silt loam	ML	A–4
			11–60	Heavy silt loam	CL	A–6
Sisson: SnA, SnB, SnC2, SnD2, SnE.	>60	>5	0–12	Fine sandy loam	SM	A–4
			12–34	Heavy loam	CL	A–6
			34–60	Silt and sand	ML	A–4
Sparta: SpB	>60	>5	0–34	Loamy fine sand	SM	A–2
			34–60	Sand	SP	A–3
Troxel: TsA	>60	3->5	0–31	Silt loam	ML or ML–CL	A–4
			31–60	Light silty clay loam	CL	A–6
Tustin: TuB	>60	>5	0–25	Loamy fine sand	SM	A–2
			25–43	Heavy silty clay loam	CL	A–7
			43–60	Silty clay loam	CL	A–7
Tustin, variant: TvA	>60	1–3	0–8	Loamy fine sand	SM	A–2
			8–27	Loamy sand	SM	A–2
			27–36	Heavy sandy loam	SM	A–4
			36–60	Heavy silty clay loam	CL	A–7
Wacousta: Wa	>60	0–1	0–17	Mucky silt loam	ML or CL	A–4
			17–60	Silt loam	ML	A–4
Wallkill: Wb [2]	>60	0–1	0–26	Silt loam	ML or ML–CL	A–4
			26–60	Muck	Pt	----------
Wasepi: WcA	>60	1–3	0–9	Fine sandy loam	SM	A–4
			9–28	Heavy sandy loam	SM	A–4
			28–60	Sand	SP	A–3
Winneshiek: WnB, WnC2	20–40	>5	0–7	Fine sandy loam	SM	A–4
			7–33	Sandy clay loam	SC	A–6
			33	Limestone.		
Wyocena: WoB, WoC2, WoD2, WoE, WxB, WxC2, WxD2.	>60	>5	0–8	Loamy sand	SM	A–2
			8–37	Sandy loam	SM	A–2
			37–60	Loamy sand	SM	A–2
WyB, WyC2, WyD2, WyE	45–60	>5	0–8	Fine sandy loam	SM	A–4
			8–50	Sandy loam	SM	A–2
			50	Sandstone.		
Yahara: YaA	>60	1–3	0–12	Fine sandy loam	SM	A–4
			12–26	Fine sandy loam	SM	A–4
			26–60	Sand and silt	SM or ML	A–4

[1] The pH in the surface layer is higher than the value shown if the soil has been limed.
[2] Subject to flooding.

properties significant in engineering—Continued

Percentage passing sieve—			Permeability	Available water capacity	Reaction [1]	Shrink-swell potential	Risk of corrosion to—	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 200 (0.074 mm)					Uncoated steel	Concrete
			Inches per hour	*Inches per inch of soil*	*pH*			
100	100	90–95	0.6–2.0	0.22–0.24	6.1–7.3			
100	100	90–95	0.6–2.0	0.18–0.20	5.6–6.5	Moderate	Moderate	Low.
95–100	90–95	40–45	0.6–6.0	0.16–0.18	[3] 6.1–7.3	Low	Moderate	Low.
85–90	80–85	25–35	2.0–6.0	0.10–0.12	7.4–8.4	Low	Moderate	Low.
100	95–100	45–50	0.6–2.0	0.15–0.17	5.6–7.3			
100	95–100	45–50	0.6–2.0	0.13–0.15	5.6–6.5	Low	Low	Moderate.
100	95–100	45–60	0.6–6.0	0.12–0.14	5.6–7.8	Low	Low	Moderate.
100	95–100	45–50	0.6–2.0	0.16–0.18	5.6–7.3			
100	95–100	45–50	0.6–2.0	0.13–0.15	5.6–6.5	Low	Moderate	Moderate.
100	95–100	45–60	0.6–6.0	0.13–0.15	5.6–7.8	Low	Moderate	Moderate.
100	100	90–95	0.6–2.0	0.22–0.24	6.1–7.3			
100	100	90–95	0.6–2.0	0.18–0.20	5.6–6.5	Moderate	Moderate	Low.
95–100	90–95	25–35	0.6–6.0	0.13–0.15	[3] 6.1–7.3	Low	Low	Low.
85–90	80–85	25–30	2.0–6.0	0.10–0.12	7.4–8.4	Low	Low	Low.
100	100	85–95	0.6–2.0	0.22–0.24	6.1–7.3			
100	100	90–95	0.6–2.0	0.19–0.21	5.1–7.3	Low	Low	Moderate.
100	95–100	40–45	0.6–2.0	0.16–0.18	5.1–7.3			
100	95–100	60–70	0.6–2.0	0.18–0.20	5.1–6.5	Moderate	Low	Moderate.
100	95–100	75–80	0.6–2.0	0.14–0.16	5.6–7.8	Low	Low	Moderate.
100	95–100	15–20	6.0–20.0	0.12–0.14	5.1–6.0	Low	Low	Moderate.
100	95–100	1–3	6.0–20.0	0.04–0.06	5.1–6.5	Low	Low	Moderate.
100	100	85–90	0.6–2.0	0.22–0.24	6.1–7.3	Low	Low	Low.
100	100	90–95	0.6–2.0	0.19–0.21	5.6–6.5	Low	High	Low.
100	90–95	15–20	6.0–20.0	0.11–0.13	5.6–7.3	Low	Low	Moderate.
100	100	90–95	0.06–0.2	0.17–0.19	[3] 6.1–7.8	High	High	Low.
100	100	95–100	0.06–0.2	0.17–0.19	7.4–8.4	High	High	Low.
100	90–100	15–20	6.0–20.0	0.11–0.13	5.6–7.3			
100	90–100	15–20	6.0–20.0	0.07–0.09	6.1–7.3	Low	Low	Low.
100	90–100	40–45	2.0–6.0	0.14–0.16	6.1–7.3	Low	Moderate	Low.
100	100	90–95	0.06–0.2	0.17–0.19	[3] 6.1–7.8	High	High	Low.
100	100	100	0.6–2.0	0.26–0.30	6.6–7.8	Low	Moderate	Low.
100	100	100	0.06–0.2	0.20–0.22	7.4–8.4	Low	Moderate	Low.
100	95–100	85–90	0.6–2.0	0.22–0.24	6.1–7.8	Low	Moderate	Low.
			2.0–6.0	0.30–0.35	5.6–7.8		Moderate	Low.
100	95–100	35–40	2.0–6.0	0.16–0.18	5.6–7.3			
95–100	85–90	40–45	2.0–6.0	0.14–0.16	[3] 5.6–7.3	Low	Moderate	Moderate.
95–100	85–90	1–3	6.0–20.0	([4])	6.1–8.4	Low	Low	Low.
100	95–100	35–45	0.6–2.0	0.16–0.18	6.1–7.3			
95–100	90–100	40–45	0.6–2.0	0.16–0.18	5.6–7.8	Moderate	Moderate	Low.
95–100	95–100	15–20	6.0–20.0	0.09–0.11	6.1–7.3			
90–100	90–100	25–35	2.0–6.0	0.12–0.14	[3] 5.6–6.5	Low	Low	Moderate.
90–100	90–100	15–20	6.0–20.0	0.08–0.10	7.4–8.4	Low	Low	Low.
95–100	90–100	25–35	2.0–6.0	0.16–0.18	6.1–7.3			
90–100	90–100	25–30	2.0–6.0	0.13–0.15	5.6–6.5	Low	Low	Moderate.
100	95–100	40–45	0.6–2.0	0.16–0.18	5.6–7.3			
100	95–100	40–45	0.6–2.0	0.14–0.16	5.1–7.3	Low	Moderate	Moderate.
100	95–100	50–55	0.6–6.0	0.14–0.16	5.6–7.8	Low	Moderate	Low.

[3] The lower part of this layer commonly has a higher pH than the value shown.
[4] No water is available to plants because roots do not penetrate this layer.

TABLE 10.—*Soil limitations to be*

Soil series and map symbols	Degree and kind of limitation for—			
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements
Adrian: Ad	Severe: high water table.	Severe: high water table; organic material; rapidly permeable substratum.	Severe: high water table; sidewall instability.	Severe: high water table.
Alluvial land, sandy: Ae.	Severe: seasonal high water table; occasionally flooded.	Severe: seasonal high water table; occasionally flooded; rapidly permeable; unstable when wet.	Severe: seasonal high water table; occasionally flooded; unstable when wet.	Severe: seasonal high water table; occasionally flooded.
Alluvial land, sandy, wet: Af.	Severe: high water table; frequently flooded.	Severe: high water table; frequently flooded; rapidly permeable; unstable when wet.	Severe: high water table; frequently flooded; unstable when wet.	Severe: high water table; frequently flooded.
Alluvial land, loamy: Ag.	Severe: seasonal high water table; occasionally flooded.	Severe: seasonal high water table; occasionally flooded; unstable when wet.	Severe: seasonal high water table; occasionally flooded; unstable when wet.	Severe: seasonal high water table; occasionally flooded.
Alluvial land, loamy, wet: Ah.	Severe: high water table; frequently flooded.	Severe: high water table; frequently flooded; unstable when wet.	Severe: high water table; frequently flooded; unstable when wet.	Severe: high water table; frequently flooded.
Atterberry: AtA, AtB	Severe: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.
Baraboo: BaB2, BaC2, BaD, BaE.	Severe: shallow over quartzite bedrock.	Severe: shallow over quartzite bedrock.	Severe: shallow over quartzite bedrock.	Severe: shallow over quartzite bedrock.
Barry: BbA	Severe: high water table.	Severe: high water table; gravelly substratum is moderately rapidly permeable; stones.	Severe: high water table; stones.	Severe: high water table; stones.
Boone: BnC, BnE	Moderate if slope is 6 to 12 percent, severe if more than 12 percent; sandstone bedrock is weakly cemented.[1]	Severe: shallow over rapidly permeable sandstone bedrock.	Moderate if slope is 6 to 12 percent, severe if more than 12 percent; sandstone bedrock is weakly cemented.	Moderate if slope is 6 to 12 percent, severe if more than 12 percent; sandstone bedrock is weakly cemented.
Boots: Bo	Severe: high water table.	Severe: high water table; organic material.	Severe: high water table; sidewall instability.	Severe: high water table; low bearing strength; high compressibility.
Boyer: BpA, BpB, BpC2, BpD2, BrA, BrB.	Slight if slope is 0 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.[1]	Severe: sandy and gravelly substratum is rapidly permeable.	Severe: sandy and gravelly substratum has sidewall instability.	Slight if slope is 0 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.
Briggsville: BsB	Severe; moderately slowly permeable; seasonal high water table in places.	Moderate: slope; moderately slowly permeable.	Severe: clayey; difficult to work.	Severe: high shrink-swell potential; low bearing strength.
Briggsville, variant: BtB2.	Severe: moderately slowly permeable substratum; seasonal high water table in places.	Moderate: slope; moderately slowly permeable substratum.	Moderate: clayey substratum difficult to work.	Severe: high shrink-swell potential; low bearing strength.

considered in town and country planning

Degree and kind of limitation for—Continued		Suitability as source of—		
Trench-type sanitary landfill	Local roads and streets	Road fill	Sand and gravel	Topsoil
Severe: high water table; rapidly permeable substratum; subsoil is organic material.	Severe: high water table; organic material.	Poor: high water table; organic material.	Good: poorly graded sand in substratum; high water table.	Poor: oxidizes rapidly; high water table.
Severe: seasonal high water table; rapidly permeable; occasionally flooded.	Severe: seasonal high water table; occasionally flooded.	Fair: seasonal high water table.	Fair: poorly graded sand with some fines; seasonal high water table.	Poor: sandy; reclamation of borrow site difficult.
Severe: high water table; rapidly permeable; frequently flooded.	Severe: high water table; frequently flooded.	Poor: high water table.	Fair: poorly graded sand with some fines; high water table.	Poor: high water table; sandy.
Severe: seasonal high water table; occasionally flooded.	Severe: seasonal high water table; occasionally flooded; highly susceptible to frost action.	Poor: seasonal high water table; highly susceptible to frost action.	Unsuited: fines	Good: thick.
Severe: high water table; frequently flooded.	Severe: high water table; frequently flooded; highly susceptible to frost action.	Poor: high water table; highly susceptible to frost action.	Unsuited: fines	Poor: high water table.
Severe: seasonal high water table.	Severe: seasonal high water table; highly susceptible to frost action.	Poor: seasonal high water table; highly susceptible to frost action.	Unsuited: fines	Fair: moderately thick.
Severe: shallow over hard quartzite bedrock.	Moderate if slope is 2 to 12 percent, severe if more than 12 percent; moderate shrink-swell potential; shallow over quartzite bedrock.	Poor: shallow over quartzite bedrock.	Unsuited: shallow over quartzite bedrock.	Fair if slope is 2 to 12 percent, poor if more than 12 percent; moderately thick.
Severe: high water table; moderately rapidly permeable substratum; stones.	Severe: high water table; stones.	Poor: high water table; stones.	Poor: pockets of poorly graded sand and gravel in places in substratum; high water table.	Poor: high water table.
Severe: shallow over rapidly permeable sandstone bedrock; rippable.	Moderate if slope is 6 to 12 percent, severe if more than 12 percent; sandstone bedrock is weakly cemented.	Fair if slope is 6 to 20 percent, poor if more than 20 percent; sandstone bedrock is weakly cemented.	Fair: poorly graded sand; sandstone bedrock is weakly cemented.	Poor: sandy; reclamation of borrow site difficult.
Severe: high water table; organic material.	Severe: high water table; organic material.	Poor: high water table; organic material.	Unsuited: organic material.	Poor: oxidizes rapidly; high water table.
Severe: rapidly permeable substratum.	Slight if slope is 0 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.	Good if slope is 0 to 12 percent, fair if more than 12 percent.	Good: poorly graded to well graded sand with some gravel in substratum.	Poor: for BpA, BpB, BpC2, and BpD2; sandy. Fair for BrA and BrB; moderately thick.
Severe: clayey; difficult to work; seasonal high water table in places.	Severe: high shrink-swell potential.	Poor: high shrink-swell potential.	Unsuited: fines	Fair: moderately thick.
Severe: clayey substratum is difficult to work; seasonal high water table in places.	Severe: substratum has high shrink-swell potential.	Poor: substratum has high shrink-swell potential.	Unsuited: fines	Fair: moderately thick.

TABLE 10.—*Soil limitations to be*

Soil series and map symbols	Degree and kind of limitation for—			
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements
Channahon: CaB, CaC2, CaE2.	Severe: shallow over limestone bedrock.	Severe: shallow over limestone bedrock.	Severe: shallow over limestone bedrock.	Severe: shallow over limestone bedrock.
Chelsea: ChB, ChC	Slight if slope is 1 to 6 percent, moderate if more than 6 percent.[1]	Severe: rapidly permeable.	Severe: sidewall instability.	Slight if slope is 1 to 6 percent, moderate if more than 6 percent.
Colwood: CoA	Severe: high water table.	Severe: high water table; moderately permeable; unstable when wet.	Severe: high water table; unstable when wet.	Severe: high water table.
Dodge: DoB2, DoC2, DoD2.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.	Severe: moderately rapidly permeable substratum has some stones.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.
Dresden: DrB, DrC2, DrD2.	Slight if slope is 1 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.[1]	Severe: sandy and gravelly substratum is rapidly permeable.	Severe: sandy and gravelly substratum has sidewall instability.	Slight if slope is 1 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.
Friesland: FrB	Slight or moderate: seasonal high water table in places.	Moderate: moderately permeable; slope; seasonal high water table in places.	Slight or moderate: seasonal high water table in places.	Moderate: moderate bearing strength; seasonal high water table in places.
Gilford, stratified substratum: GaA.	Severe: high water table.	Severe: high water table; moderately permeable; unstable when wet.	Severe: high water table; unstable when wet.	Severe: high water table.
Granby: Gb	Severe: high water table.	Severe: high water table; rapidly permeable; unstable when wet.	Severe: high water table; unstable when wet.	Severe: high water table.
Grellton:: GeB, GeC2	Slight or moderate if slope is 1 to 6 percent, moderate if 6 to 12 percent; seasonal high water table in places.	Severe: moderately rapidly permeable substratum has some stones; seasonal high water table in places; slope.	Slight or moderate if slope is 1 to 6 percent, moderate if more than 6 percent; seasonal high water table in places.	Slight or moderate if slope is 1 to 6 percent, moderate if more than 6 percent; seasonal high water table in places.
Grellton, variant: GnA.	Severe: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.
Griswold: GrB2, GrC2, GrD2.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.	Severe: moderately rapidly permeable substratum has some stones.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.
Houghton: Ho	Severe: high water table.	Severe: high water table; organic material.	Severe: high water table; sidewall instability.	Severe: high water table; low bearing strength; high compressibility.
Joy: JoA	Severe: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.
Kibbie: KbA	Severe: seasonal high water table.	Severe: seasonal high water table; unstable when wet.	Severe: seasonal high water table; unstable when wet.	Severe: seasonal high water table.

considered in town and country planning—Continued

Degree and kind of limitation for—Continued		Suitability as source of—		
Trench-type sanitary landfill	Local roads and streets	Road fill	Sand and gravel	Topsoil
Severe: shallow over fractured limestone bedrock; hard.	Severe: shallow over limestone bedrock; bedrock outcrops.	Poor: shallow over limestone bedrock.	Unsuited: shallow over limestone bedrock.[2]	Fair if slope is 2 to 12 percent, poor if more than 12 percent; moderately thick; bedrock outcrops.
Severe: rapidly permeable subsoil; moderately rapidly permeable substratum.	Slight if slope is 1 to 6 percent, moderate if more than 6 percent.	Good	Fair: poorly drained sand has some fines in subsoil.	Poor: sandy; reclamation of borrow site difficult.
Severe: high water table.	Severe: high water table; highly susceptible to frost action.	Poor: high water table; highly susceptible to frost action.	Unsuited: fines	Poor: high water table.
Moderate: moderately rapidly permeable substratum has some stones; slope.[3]	Moderate if slope is 2 to 12 percent, severe if more than 12 percent; moderate shrink-swell potential.	Fair: moderate shrink-swell potential; fines.	Poor: pockets of poorly graded sand and gravel in places in substratum.	Fair if slope is 2 to 12 percent, poor if more than 12 percent; slope; moderately thick.
Severe: rapidly permeable substratum.	Slight if slope is 1 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent; fines in subsoil.	Good if slope is 1 to 12 percent, fair if more than 12 percent; fines in subsoil.	Good: poorly graded to well graded, sandy and gravelly in substratum.	Fair if slope is 1 to 12 percent, poor if more than 12 percent; moderately thick.
Slight or moderate: seasonal high water table in places.	Moderate: moderate shrink-swell potential.	Fair: moderate shrink-swell potential; fines.	Unsuited: fines	Good: thick.
Severe: high water table.	Severe: high water table; highly susceptible to frost action.	Poor: high water table; highly susceptible to frost action.	Poor: poorly graded fine sand has layers of silt.	Poor: high water table.
Severe: high water table; rapidly permeable.	Severe: high water table.	Poor: high water table.	Good: poorly graded sand; high water table.	Poor: high water table; sandy.
Moderate: moderately rapidly permeable substratum has some stones; seasonal high water table in places.	Moderate: moderate shrink-swell potential.	Fair: moderate shrink-swell potential; fines.	Poor: pockets of poorly graded sand and gravel in places in substratum; seasonal high water table in places.	Fair: moderately thick.
Severe: seasonal high water table.	Severe: seasonal high water table; highly susceptible to frost action.	Poor: seasonal high water table; highly susceptible to frost action.	Unsuited: fines	Fair: moderately thick.
Moderate: moderately rapidly permeable substratum has some stones; slope.[3]	Moderate if slope is 2 to 6 percent, severe if more than 6 percent; moderate shrink-swell potential.	Fair: moderate shrink-swell potential; fines.	Poor: pockets of poorly graded sand and gravel in places in substratum.	Fair if slope is 2 to 12 percent, poor if more than 12 percent; moderately thick.
Severe: high water table; organic material.	Severe: high water table; organic material.	Poor: high water table; organic material.	Unsuited: organic material.	Poor: oxidizes rapidly; high water table.
Severe: seasonal high water table.	Severe: seasonal high water table; highly susceptible to frost action.	Poor: seasonal high water table; highly susceptible to frost action.	Unsuited: fines	Good: thick.
Severe: seasonal high water table.	Severe: seasonal high water table; highly susceptible to frost action.	Poor: seasonal high water table; highly susceptible to frost action.	Unsuited: fines	Fair: moderately thick.

TABLE 10.—*Soil limitations to be*

Soil series and map symbols	Degree and kind of limitation for—			
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements
Knowles: KnB, KnC2, KnD2.	Severe: shallow over limestone bedrock.	Severe: shallow over limestone bedrock.	Severe: shallow over limestone bedrock.	Severe: shallow over limestone bedrock.
Lapeer: LaB, LaC2, LaD2, LaE2.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.	Severe: moderately rapidly permeable, gravelly substratum; stones.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent; stones.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent; stones.
Lorenzo: LoB, LoC2, LoD2.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.[1]	Severe: rapidly permeable; sandy and gravelly substratum.	Severe: sandy and gravelly substratum has sidewall instability.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.
Marcellon: MaB	Severe: seasonal high water table.	Severe: seasonal high water table; moderately rapidly permeable substratum; stones.	Severe: seasonal high water table; stones.	Severe: seasonal high water table; stones.
Marsh: Mb	Severe: flooded most of the time.	Severe: flooded most of the time.	Severe: flooded most of the time.	Severe: flooded most of the time.
Marshan: Mc	Severe: high water table.	Severe: high water table; rapidly permeable substratum is unstable when wet.	Severe: high water table; substratum is nnstable when wet.	Severe: high water table.
McHenry: MeB2, MeC2, MeD2.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.	Severe: moderately rapidly permeable substratum has some stones.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.
Military: MnB, MnC2, MnD2.	Moderate if slope is 2 to 12 percent, severe if more than 12 percent; shallow over sandstone bedrock.[1]	Severe: shallow over moderately rapidly permeable sandstone bedrock; stones.	Moderate if slope is 2 to 12 percent, severe if more than 12 percent; shallow over sandstone bedrock; stones.	Moderate if slope is 2 to 12 percent, severe if more than 12 percent; sandstone bedrock; stones.
Morocco: MoA	Severe: seasonal high water table.	Severe: seasonal high water table; rapidly permeable; unstable when wet.	Severe: seasonal high water table; unstable when wet.	Severe: seasonal high water table.
Mt. Carroll: MrD2, MtA, MtB, MtC2.	Severe: seasonal high water table; moderately slowly permeable substratum.	Moderate if slope is 0 to 6 percent, severe if more than 6 percent; substratum is unstable when wet; moderately permeable subsoil.	Moderate if slope is 0 to 12 percent, severe if more than 12 percent; seasonal high water table; substratum is unstable when wet.	Moderate if slope is 0 to 12 percent, severe if more than 12 percent; seasonal high water table; moderate bearing strength.
Northfield: NoB, NoC, NoE.	Severe: shallow over sandstone bedrock.[1]	Severe: shallow over moderately rapidly permeable sandstone bedrock; stones.	Moderate if slope is 2 to 12 percent, severe if more than 12 percent; shallow over sandstone bedrock; stones.	Moderate if slope is 2 to 12 percent, severe if more than 12 percent; shallow over sandstone bedrock; stones.
Okee: OkB, OkC	Slight if slope is 2 to 6 percent, moderate if more than 6 percent.	Severe: moderately rapidly permeable substatum has some stones.	Slight if slope is 2 to 6 percent, moderate if more than 6 percent.	Slight if slope is 2 to 6 percent, moderate if more than 6 percent.
Oshtemo: OmA, OmB, OmC2, OmD2.	Slight if slope is 0 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.[1]	Severe: rapidly permeable substratum is sandy and gravelly.	Severe: sandy and gravelly substratum has sidewall instability.	Slight if slope is 0 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.

considered in town and country planning—Continued

Degree and kind of limitation for—Continued		Suitability as source of—		
Trench-type sanitary landfill	Local roads and streets	Road fill	Sand and gravel	Topsoil
Severe: shallow over limestone bedrock; hard.	Moderate if slope is 2 to 12 percent, severe if more than 12 percent; moderate shrink-swell potential; shallow over limestone bedrock.	Poor: shallow over limestone bedrock.	Unsuited: shallow over limestone bedrock.[2]	Fair if slope if 2 to 12 percent, poor if more than 12 percent; moderately thick.
Moderate if slope is 2 to 20 percent, severe if more than 20 percent; moderately rapidly permeable substratum; stones.[2]	Moderate if slope is 2 to 12 percent; severe if more than 12 percent; fines; stones.	Fair if slope is 2 to 20 percent, severe if more than 20 percent; fines; stones.	Poor: pockets of poorly graded sand and gravel in places in substratum.	Fair if slope is 2 to 12 percent, poor if more than 12 percent; moderately thick; some gravel.
Severe: rapidly permeable substratum.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent; severe if more than 12 percent; fines in subsoil.	Good if slope is 2 to 12 percent, fair if more than 12 percent; fines in subsoil.	Good: poorly graded to well graded sand and gravel in substratum.	Fair if slope is 2 to 12 percent, poor if more than 12 percent; moderately thick.
Severe: seasonal high water table; moderately rapidly permeable substratum; stones.	Moderate: seasonal high water table; moderately susceptible to frost action; stones.	Fair: seasonal high water table; moderately susceptible to frost action; stones; fines.	Poor: pockets of poorly graded sand and gravel in places in substratum; seasonal high water table.	Good: thick.
Severe: flooded most of the time.	Severe: flooded most of the time.	Poor: flooded most of the time.	Unsuited: flooded most of the year.	Poor: flooded most of the time.
Severe: high water table; rapidly permeable substratum.	Severe: high water table; moderate shrink-swell potential.	Poor: high water table.	Good: poorly graded sand in substratum; high water table.	Poor: high water table.
Moderate:: moderately rapidly permeable substratum has some stones; slope.[2]	Moderate if slope is 2 to 12 percent, severe if more than 12 percent; moderate shrink-swell potential.	Fair: moderate shrink-swell potential; fines.	Poor: pockets of poorly graded sand and gravel in places in substratum.	Fair if slope is 2 to 12 percent, poor if more than 12 percent; slopes moderately thick.
Severe: shallow over moderately rapidly permeable sandstone bedrock; weakly to strongly cemented; stones.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent; shallow over sandstone bedrock; stones.	Fair: stones; slope; fines; shallow over sandstone bedrock.	Unsuited: shallow over sandstone bedrock.	Fair if slope is 2 to 12 percent, poor if more than 12 percent; moderately thick; some gravel.
Severe: seasonal high water table; rapidly permeable.	Moderate: seasonal high water table.	Fair: seasonal high water table.	Good: poorly graded sand; seasonal high water table.	Poor: sandy; reclamation of borrow site difficult.
Slight or moderate if slope is 0 to 12 percent, moderate if more than 12 percent; seasonal high water table.	Moderate if slope is 0 to 12 percent, severe if more than 12 percent; fines.	Fair: moderately susceptible to frost action; fines.	Unsuited: fines	Fair if slope is 0 to 12 percent, poor if more than 12 percent; moderately thick.
Severe: shallow over moderately rapidly permeable sandstone bedrock; weakly to strongly cemented; stones.	Moderate if slope is 2 to 12 percent, severe if more than 12 percent; shallow over standstone bedrock; stones.	Fair if slope is 2 to 20 percent, severe if more than 20 percent; shallow over sandstone bedrock; stones; fines.	Unsuited: shallow over sandstone bedrock.	Fair: thin; erodible; some gravel.
Moderate: moderately rapidly permeable substratum has some stones.[2]	Moderate: moderate shrink-swell potential.	Fair: moderate shrink-swell potential; fines.	Poor: pockets of poorly graded sand and gravel in places in substratum.	Poor: sandy; reclamation of borrow site difficult.
Severe: rapidly permeable substratum.	Slight if slope is 0 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.	Good if slope is 0 to 12 percent, fair if more than 12 percent.	Good: poorly graded to well graded sand with some gravel in substratum.	Poor: sandy.

TABLE 10.—*Soil limitations to be*

Soil series and map symbols	Degree and kind of limitation for—			
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements
Ossian: OsA	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.
Otter: Ot	Severe: high water table; frequently flooded.	Severe: high water table; frequently flooded.	Severe: high water table; frequently flooded.	Severe: high water table; frequently flooded.
Palms: Pa	Severe: high water table.	Severe: high water table; organic material.	Severe: high water table; sidewall instability.	Severe: high water table.
Plainfield: PeC2, PfA, PfB, PfC, PfD.	Slight if slope is 0 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.[1]	Severe: rapidly permeable.	Severe: sidewall instability.	Slight if slope is 0 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.
PkB, PkC, PkD	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.	Severe: rapidly permeable.	Severe: sidewall instability.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.
Plano: PnA, PnB, PnC2	Slight or moderate if slope is 0 to 6 percent, moderate if more than 6 percent; seasonal high water table in places.	Severe: moderately rapidly permeable substratum has some stones; seasonal high water table in places; slope.	Slight or moderate if slope is 0 to 6 percent, moderate if more than 6 percent; seasonal high water table in places.	Slight or moderate if slope is 0 to 6 percent, moderate if more than 6 percent; seasonal high water table in places.
Poygan: PoA	Severe: high water table; slowly permeable.	Moderate: high water table; slowly permeable.	Severe: high water table; clayey; difficult to work.	Severe: high water table; high shrink-swell potential.
Puchyan: PuB, PuC	Slight or moderate if slope is 2 to 6 percent, moderate if more than 6 percent; seasonal high water table in places.	Moderate if slope is 2 to 6 percent, severe if more than 6 percent; moderately permeable substratum; seasonal high water table in places.	Slight or moderate if slope is 2 to 6 percent, moderate if more than 6 percent; seasonal high water table in places.	Moderate: seasonal high water table in places; moderate bearing strength; slope.
Ringwood: RdB2, RdC2	Slight if slope is 1 to 6 percent, moderate if more than 6 percent.	Severe: moderately rapidly permeable substratum has some stones.	Slight if slope is 1 to 6 percent, moderate if more than 6 percent.	Slight if slope is 1 to 6 percent, moderate if more than 6 percent.
Ripon: ReB, ReC2	Severe: shallow over limestone bedrock.	Severe: shallow over limestone bedrock.	Severe: shallow over limestone bedrock.	Severe: shallow over limestone bedrock.
Rock land: Rk	Severe: bedrock at or near the surface; slope.	Severe: bedrock at or near the surface; slope.	Severe: bedrock at or near the surface; slope.	Severe: bedrock at or near the surface; slope.
Rodman: RoC, RoD, RoE	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.[1]	Severe: sandy and gravelly; very rapidly permeable substratum.	Severe: sandy and gravelly substratum has sidewall instability.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.
Rotamer: RtB, RtC2, RtD2, RtE2.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.	Severe: gravelly substratum is moderately rapidly permeable; stones.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent; stones.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent; stones.

considered in town and country planning—Continued

Degree and kind of limitation for—Continued		Suitability as source of—		
Trench-type sanitary landfill	Local roads and streets	Road fill	Sand and gravel	Topsoil
Severe: high water table.	Severe: high water table; highly susceptible to frost action.	Poor: high water table; highly susceptible to frost action.	Unsuited: fines	Poor: high water table.
Severe: high water table; frequently flooded.	Severe: high water table; highly susceptible to frost action; frequently flooded.	Poor: high water table; highly susceptible to frost action.	Unsuited: fines	Poor: high water table.
Severe: high water table; subsoil is organic material.	Severe: high water table; organic material.	Poor: high water table; organic material.	Unsuited: organic material; fines in substratum.	Poor: oxidizes rapidly; high water table.
Severe: rapidly permeable.	Slight if slope is 0 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.	Good if slope is 0 to 12 percent, fair if more than 12 percent.	Good: poorly graded sand.	Poor: sandy; reclamation of borrow site difficult.
Severe: subsoil is rapidly permeable. Substratum is variably permeable.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.	Good if slope is 0 to 12 percent, fair if more than 12 percent.	Fair: poorly graded sandy in subsoil.	Poor: sandy; reclamation of borrow site difficult.
Moderate: moderately rapidly permeable substratum has some stones; seasonal high water table in places.	Moderate: moderate shrink-swell potential.	Fair: moderate shrink-swell potential; fines.	Poor: pockets of poorly graded sand and gravel in places in substratum; seasonal high water table in places.	Good if slope is 0 to 6 percent, fair if more than 6 percent; thick.
Severe: high water table; clayey; difficult to work.	Severe: high water table; high shrink-swell potential.	Poor: high water table; high shrink-swell potential.	Unsuited: fines	Poor: high water table.
Slight or moderate: seasonal high water table in places.	Moderate: fines	Fair: fines	Unsuited: fines	Poor: sandy; reclamation of borrow site difficult.
Moderate: moderately rapidly permeable substratum has some stones.[3]	Moderate: moderate shrink-swell potential.	Fair: moderate shrink-swell potential; fines.	Poor: pockets of poorly graded sand and gravel in places in substratum.	Fair: moderately thick.
Severe: shallow over fractured limestone bedrock; hard.	Moderate: moderate shrink-swell potential; shallow over limestone bedrock.	Poor: shallow over limestone bedrock.	Unsuited: shallow over limestone bedrock.[2]	Fair: moderately thick.
Severe: bedrock at or near the surface; slope.	Severe: bedrock at or near the surface; slope.	Poor: bedrock at or near the surface; slope.	Unsuited: bedrock at or near the surface.	Poor: many bedrock outcrops; too steep.
Severe: very rapidly permeable; slope.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.	Good if slope is 2 to 12 percent, fair if 12 to 20 percent, poor if more than 20 percent.	Good: poorly graded to well graded sand and gravel in substratum.	Poor: thin; gravelly.
Moderate if slope is 2 to 20 percent, severe if more than 20 percent; moderately rapidly permeable substratum; stones.[3]	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent; stones.	Good if slope is 2 to 12 percent, moderate if 12 to 20 percent, severe if more than 20 percent; stones; some fines.	Poor: pockets of poorly graded sand and gravel in places in substratum.	Fair if slope is 2 to 12 percent, poor if more than 12 percent; moderately thick; some gravel.

TABLE 10.—*Soil limitations to be*

Soil series and map symbols	Degree and kind of limitation for—			
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements
St. Charles: SaA, SaB2, SaC2, SaD2, SaE.	Slight or moderate if slope is 0 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent; seasonal high water table in places.	Severe: moderately rapidly permeable substratum has some stones; seasonal high water table in places; stones.	Slight or moderate if slope if 0 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent; seasonal high water table in places.	Slight or moderate if slope if 0 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent; seasonal high water table in places.
Salter: SbA, SbB, SbC2, SbD2.	Moderate: unstable when wet.	Moderate if slope is 0 to 6 percent, severe if more than 6 percent; moderately permeable; unstable when wet.	Slight if slope is 0 to 6 percent, moderate if more than 6 percent.	Moderate: moderate bearing strength.
Salter, variant: ScB	Moderate: seasonal high water table in places; unstable when wet.	Moderate: moderately permeable; unstable when wet; seasonal high water table in places; slope.	Slight or moderate: seasonal high water table in places; unstable when wet.	Moderate: moderate bearing strength; seasonal high water table in places.
Sandy land: Sd. No interpretations made; material too variable. Onsite investigation needed.				
Saybrook: SeB2, SeC2, SeD2.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.	Severe: moderately rapidly permeable substratum has some stones.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.
Seaton: SfA, SfB2, SfC2, SfD2.	Slight if slope is 0 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.	Moderate if slope is 0 to 6 percent, severe if more than 6 percent; moderately permeable.	Slight if slope is 0 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.	Moderate if slope is 0 to 12 percent, severe if more than 12 percent; moderate bearing strength.
Sisson: SnA, SnB, SnC2, SnD2, SnE.	Moderate if slope is 0 to 12 percent, severe if more than 12 percent; unstable when wet.	Moderate if slope is 0 to 6 percent, severe if more than 6 percent; moderately permeable; unstable when wet.	Slight if slope is 0 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.	Moderate if slope is 0 to 12 percent, severe if more than 12 percent; moderate bearing strength.
Sparta: SpB	Slight[1]	Severe: rapidly permeable.	Severe: sidewall instability.	Slight
Troxel: TsA	Moderate: seasonal high water table in places.	Moderate: moderately permeable; seasonal high water table in places.	Slight or moderate: seasonal high water table in places.	Moderate: moderate bearing strength; seasonal high water table in places.
Tustin: TuB	Severe: slowly permeable in lower part of subsoil and substratum.	Moderate: slope; slowly permeable substratum; rapidly permeable subsoil.	Moderate: clayey substratum is difficult to work.	Moderate: high shrink-swell potential.
Tustin, variant: TvA	Severe: seasonal high water table; slowly permeable substratum.	Moderate: seasonal high water table; slowly permeable substratum.	Severe: seasonal high water table; clayey substratum difficult to work.	Severe: seasonal high water table; high shrink-swell potential.
Wacousta: Wa	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.
Wallkill: Wb	Severe: high water table; frequently flooded.	Severe: high water table; organic material; frequently flooded.	Severe: high water table; frequently flooded.	Severe: high water table; frequently flooded; low bearing strength; high compressibility.

considered in town and country planning—Continued

Degree and kind of limitation for—Continued		Suitability as source of—		
Trench-type sanitary landfill	Local roads and streets	Road fill	Sand and gravel	Topsoil
Moderate if slope is 0 to 20 percent, severe if more than 20 percent; moderately rapidly permeable substratum; seasonal high water table in places.	Moderate if slope is 0 to 12 percent, severe if more than 12 percent; moderate shrink-swell potential.	Fair if slope is 0 to 20 percent, poor if more than 20 percent; moderate shrink-swell potential; fines.	Poor: pockets of poorly graded sand and gravel in places in substratum; seasonal high water table in places.	Fair if slope is 0 to 12 percent, poor if more than 12 percent; moderately thick.
Slight	Moderate: fines	Fair: fines	Poor: poorly graded fine sand has layers of silt.	Good if slope is 0 to 6 percent, fair if more than 6 percent; thick.
Slight to moderate: seasonal high water table in places.	Moderate: fines	Fair: fines	Poor: poorly graded fine sand has layers of silt; seasonal high water table in places.	Good: thick.
Moderate: moderately rapidly permeable substratum has some stones; slope.[3]	Moderate: if slope is 2 to 12 percent, severe if more than 12 percent; moderate shrink-swell potential.	Fair: moderate shrink-swell potential; fines.	Poor: pockets of poorly graded sand and gravel in places in substratum.	Fair if slope is 2 to 12 percent, poor if more than 12 percent; moderately thick.
Slight if slope is 0 to 12 percent, moderate if more than 12 percent.	Moderate if slope is 0 to 12 percent, severe if more than 12 percent; fines.	Fair: fines	Unsuited: fines	Good if slope is 0 to 6 percent, fair if 6 to 12 percent, poor if more than 12 percent; thick.
Slight if slope is 0 to 12 percent, moderate if 12 to 20 percent, severe if more than 20 percent.	Moderate if slope is 0 to 12 percent, severe if more than 12 percent; moderate shrink-swell potential.	Fair if slope is 0 to 20 percent, poor if more than 20 percent; moderate shrink-swell potential; fines.	Unsuited: fines	Fair if slope is 0 to 12 percent, poor if more than 12 percent; moderately thick.
Severe: rapidly permeable.	Slight	Good	Good: poorly graded sand.	Poor: sandy; reclamation of borrow site difficult.
Slight or moderate: seasonal high water table in places.	Moderate: fines; subject to overwash.	Fair: fines; moderately susceptible to frost action.	Unsuited: fines	Good: thick.
Moderate: clayey substratum difficult to work.	Severe: substratum has high shrink-swell potential.	Poor: substratum has high shrink-swell potential.	Unsuited: too shallow to fines.	Poor: sandy; reclamation of borrow site difficult.
Severe: seasonal high water table; clayey substratum difficult to work.	Severe: seasonal high water table; substratum has high shrink-swell potential.	Poor: seasonal high water table; substratum has high shrink-swell potential.	Unsuited: too shallow to fines.	Poor: sandy; reclamation of borrow site difficult.
Severe: high water table.	Severe: high water table; highly susceptible to frost action.	Poor: high water table; highly susceptible to frost action.	Unsuited: fines	Poor: high water table.
Severe: high water table; frequently flooded; substratum is organic material.	Severe: high water table; substratum is organic material; frequently flooded.	Poor: high water table; substratum is organic material.	Unsuited: fines: substratum is organic material.	Poor: high water table.

TABLE 10.—*Soil limitations to be*

Soil series and map symbols	Degree and kind of limitation for—			
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements
Wasepi: WcA	Severe: seasonal high water table.	Severe: seasonal high water table; rapidly permeable substratum is unstable when wet.	Severe: seasonal high water table; substratum is unstable when wet.	Severe: seasonal high water table.
Winneshiek: WnB, WnC2.	Severe: shallow over limestone bedrock.	Severe: shallow over limestone bedrock; stones.	Severe: shallow over limestone bedrock; stones.	Severe: shallow over limestone bedrock; stones.
Wyocena: WoB, WoC2, WoD2, WoE, WxB, WxC2, WxD2.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent.[1]	Severe: moderately rapidly permeable substratum; stones.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent; stones.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent. severe if more than 12 percent; stones.
WyB, WyC2, WyD2, WyE.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent; substratum is sandstone bedrock.[1]	Severe: substratum is rapidly permeable sandstone bedrock; stones.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent; substratum is sandstone bedrock; stones.	Slight if slope is 2 to 6 percent, moderate if 6 to 12 percent, severe if more than 12 percent; substratum is sandstone bedrock; stones.
Yahara: YaA	Severe: seasonal high water table.	Severe: seasonal high water table; moderately permeable; unstable when wet.	Severe: seasonal high water table; unstable when wet.	Severe: seasonal high water table.

[1] Poor filtering material; hazard of contaminating nearby water supplies.
[2] Source of limestone for crushing.
[3] Probably *moderate* to a depth of 12 feet.

TABLE 11.—*Estimated engineering*

Soil series and map symbols	Soil features affecting—	
	Pond reservoir areas	Dikes, levees, and other embankments
Adrian: Ad	Moderately rapidly permeable subsoil; rapidly permeable substratum; high water table.	Subsoil is organic material and unsuitable. Substratum has medium shear strength; good compaction, piping hazard.
Alluvial land, sandy: Ae	Rapidly permeable; occasionally flooded; seasonal high water table.	Medium shear strength; fair to good compaction; piping hazard.
Alluvial land, sandy, wet: Af	Rapidly permeable; frequently flooded; high water table.	Medium shear strength; fair to good compaction; piping hazard.
Alluvial land, loamy: Ag	Moderately permeable; occasionally flooded; seasonal high water table.	Low to medium shear strength; fair to poor compaction; piping hazard.
Alluvial land, loamy, wet: Ah	Moderately permeable, frequently flooded; high water table.	Low to medium shear strength; fair to poor compaction; piping hazard.

considered in town and country planning—Continued

Degree and kind of limitation for—Continued		Suitability as source of—		
Trench-type sanitary landfill	Local roads and streets	Road fill	Sand and gravel	Topsoil
Severe: seasonal high water table; rapidly permeable substratum.	Moderate: seasonal high water table; moderately susceptible to frost action.	Fair: seasonal high water table; moderately suspectible to frost action.	Good: poorly graded to well graded sand with some gravel in substratum; seasonal high water table.	Fair: moderately thick; some gravel.
Severe: shallow over fractured limestone bedrock; hard; stones.	Moderate: moderate shrink-swell potential; shallow over limestone bedrock; stones.	Poor: shallow over limestone bedrock; stones.	Unsuited: shallow over limestone bedrock.[2]	Fair: moderately thick; some gravel.
Severe: moderately rapidly permeable substratum; stones.	Slight if slope is 2 to 6 percent moderate if 6 to 12 percent, severe if more than 12 percent; stones.	Good if slope is 2 to 12 percent, fair if 12 to 20 percent, severe if more than 20 percent; stones.	Poor: poorly graded to well graded sand with some gravel and fines.	Poor for WoB, WoC2, WoD2, and WoE; sandy. Fair for WxB, WxC2, and WxD2 if slope is 2 to 12 percent, poor if more than 12 percent; moderately thick; some gravel.
Severe: shallow over rapidly permeable sandstone bedrock; rippable.	Moderate if slope is 2 to 12 percent, severe if more than 12 percent; substratum is sandstone bedrock; fines; stones.	Fair if slope is 2 to 20 percent, poor if more than 20 percent; substratum is sandstone bedrock; stones; fines.	Poor: poorly graded to well graded sand with some gravel and fines in subsoil; substratum is sandstone bedrock.	Fair if slope is 2 to 12 percent, poor if more than 12 percent; moderately thick; some gravel.
Severe: seasonal high water table.	Severe: seasonal high water table; highly susceptible to frost action.	Poor: seasonal high water table; highly susceptible to frost action.	Poor: poorly graded fine sand has layers of silt; seasonal high water table.	Good: thick; sandy layers in places.

interpretations for specified uses

Soil features affecting—Continued		
Drainage for crops and pasture	Irrigation	Terraces and diversions
High water table; moderately rapidly permeable subsoil; rapidly permeable substratum; unstable when wet.	High available water capacity; moderately rapidly permeable; very poorly drained; soil blowing hazard.	Slopes of 0 to 2 percent; very poorly drained; organic material.
Seasonal high water table; rapidly permeable; occasionally flooded; unstable when wet.	Low available water capacity; rapidly permeable; moderately well drained to somewhat poorly drained; occasionally flooded; soil blowing hazard.	Slopes of 0 to 3 percent; moderately well drained to somewhat poorly drained; occasionally flooded; sandy.
High water table; rapidly permeable; frequently flooded; unstable when wet.	Low available water capacity; rapidly permeable; poorly drained to very poorly drained; frequently flooded; soil blowing hazard.	Slopes of 0 to 2 percent; poorly drained to very poorly drained; frequently flooded; sandy.
Seasonal high water table; moderately permeable; occasionally flooded; unstable when wet; ponding in places.	High available water capacity; moderately permeable; moderately well drained to somewhat poorly drained; occasionally flooded.	Slopes of 0 to 3 percent; moderately well drained to somewhat poorly drained; occasionally flooded.
High water table; moderately permeable; frequently flooded; unstable when wet; ponding.	High available water capacity; moderately permeable; poorly drained to very poorly drained; frequently flooded.	Slopes of 0 to 2 percent; poorly drained to very poorly drained; frequently flooded.

TABLE 11.—*Estimated engineering*

Soil series and map symbols	Soil features affecting—	
	Pond reservoir areas	Dikes, levees, and other embankments
Atterberry: AtA, AtB	Moderately permeable to moderately slowly permeable; seasonal high water table.	Medium shear strength; fair compaction
Baraboo: BaB2, BaC2, BaD, BaE	Moderately permeable subsoil; hard quartzite bedrock at a depth of 20 to 40 inches.	Medium shear strength; fair to good compaction; quartzite bedrock at a depth of 20 to 40 inches.
Barry: BbA	Moderately permeable subsoil; moderately rapidly permeable substratum; high water table.	Medium shear strength; fair to good compaction; stones.
Boone: BnC, BnE	Rapidly permeable subsoil; rapidly permeable, weakly cemented sandstone bedrock at a depth of 20 to 40 inches.	Medium shear strength; fair to good compaction; piping hazard; sandstone bedrock at a depth of 20 to 40 inches.
Boots: Bo	Moderately rapidly permeable; high water table.	Unsuited: organic material
Boyer: BpA, BpB, BpC2, BpD2, BrA, BrB	Moderately rapidly permeable subsoil; rapidly permeable substratum.	Medium shear strength; fair to good compaction; piping hazard.
Briggsville: BsB	Moderately slowly permeable	Medium to low shear strength; fair to poor compaction; high shrink-swell potential.
Briggsville, variant: BtB2	Moderately permeable subsoil; moderately slowly permeable substratum.	Subsoil has medium shear strength, fair to good compaction. Substratum has low to medium shear strength, fair to poor compaction, high shrink-swell potential.
Channahon: CaB, CaC2, CaE2	Moderately permeable subsoil; fractured limestone bedrock at a depth of 10 to 20 inches.	Low to medium shear strength; fair compaction; limestone bedrock at a depth of 10 to 20 inches.
Chelsea: ChB, ChC	Rapidly permeable subsoil; moderately rapidly permeable substratum.	Medium shear strength; fair to good compaction; piping hazard.
Colwood: CoA	Moderately permeable; high water table	Subsoil has medium shear-strength, fair to good compaction. Substratum has low to medium shear strength, fair to poor compaction, piping hazard.
Dodge: DoB2, DoC2, DoD2	Moderately permeable subsoil; moderately rapidly permeable substratum.	Medium shear strength; fair to good compaction; stones in substratum.
Dresden: DrB, DrC2, DrD2	Moderately permeable subsoil; rapidly to very rapidly permeable substratum.	Subsoil has medium shear strength, fair to good compaction. Substratum has high shear strength, good compaction.
Friesland: FrB	Moderately permeable	Medium to low shear strength; fair to good compaction; piping hazard.
Gilford, stratified substratum: GsA	Moderately permeable; high water table	Low to medium shear strength; fair compaction; piping hazard.
Granby: Gb	Rapidly permeable; high water table	Medium shear strength; good compaction; piping hazard.
Grellton: GeB, GeC2	Moderately permeable subsoil; moderately rapidly permeable substratum.	Subsoil has medium to low shear strength, fair to good compaction, piping hazard. Substratum has medium shear strength, fair to good compaction, stones.
Grellton, variant: GnA	Moderately permeable; seasonal high water table.	Medium to low shear strength; fair compaction; piping hazard.
Griswold: GrB2, GrC2, GrD2	Moderately permeable subsoil; moderately rapidly permeable substratum.	Medium shear strength; fair to good compaction; stones.
Houghton: Ho	Moderately rapidly permeable; high water table.	Unsuited: organic material

interpretations for specified uses—Continued

Soil features affecting—Continued		
Drainage for crops and pasture	Irrigation	Terraces and diversions
Seasonal high water table; moderately to moderately slowly permeable; ponding on AtA.	High available water capacity; moderately permeable to moderately slowly permeable; somewhat poorly drained.	Slopes of 0 to 6 percent; somewhat poorly drained.
Natural drainage is adequate	Medium available water capacity; moderately permeable; bedrock at a depth of 20 to 40 inches.	Slopes of 2 to 30 percent; quartzite bedrock at a depth of 20 to 40 inches.
High water table; moderately permeable subsoil; moderately rapidly permeable substratum; ponding.	High available water capacity; moderately permeable; poorly drained; stones.	Slopes of 0 to 3 percent; poorly drained; calcareous till at a depth of 24 to 50 inches; stones.
Natural drainage is excessive	Very low available water capacity; rapidly permeable; bedrock at a depth of 20 to 40 inches; soil blowing hazard.	Slopes of 6 to 45 percent; sandstone bedrock at a depth of 20 to 40 inches; sandy; difficult to vegetate; soil blowing hazard.
High water table; moderately rapidly permeable; unstable when wet.	Very high available water capacity; moderately rapidly permeable; very poorly drained; soil blowing hazard.	Slopes of 0 to 2 percent; very poorly drained; organic material.
Natural drainage is adequate	Low available water capacity; moderately rapidly permeable; soil blowing hazard.	Slopes of 0 to 30 percent; sandy; difficult to vegetate in places; soil blowing hazard; sand and gravel at a depth of 24 to 40 inches.
Natural drainage is adequate	High available water capacity; moderately slowly permeable; slow water intake rate.	Slopes of 2 to 8 percent; clayey; difficult to work.
Natural drainage is adequate	High available water capacity; moderately to moderately slowly permeable.	Slopes of 1 to 6 percent; clayey material at a depth of 30 to 40 inches.
Natural drainage is adequate	Low available water capacity; moderately permeable; bedrock at a depth of 10 to 20 inches.	Slopes of 2 to 30 percent; limestone bedrock at a depth of 10 to 20 inches; rock outcrops.
Natural drainage is excessive	Low available water capacity; rapidly permeable; soil blowing hazard.	Slopes of 1 to 12 percent; sandy; difficult to vegetate; soil blowing hazard.
High water table; moderately permeable; unstable when wet.	High available water capacity; moderately permeable; poorly drained.	Slopes of 0 to 3 percent; poorly drained.
Natural drainage is adequate	High available water capacity; moderately permeable.	Slopes of 2 to 20 percent; calcareous till at a depth of 30 to 40 inches.
Natural drainage is adequate	Medium available water capacity; moderately permeable; sand and gravel at a depth of 24 to 40 inches.	Slopes of 1 to 20 percent; sand and gravel at a depth of 24 to 40 inches.
Natural drainage is adequate	High available water capacity; moderately permeable.	Slopes of 1 to 6 percent.
High water table; moderately permeable; unstable when wet.	Medium available water capacity; moderately permeable; poorly drained.	Slopes of 0 to 3 percent; poorly drained.
High water table; rapidly permeable; unstable when wet.	Low available water capacity; rapidly permeable; poorly drained; soil blowing hazard.	Slopes of 0 to 2 percent; poorly drained; sandy; difficult to vegetate; soil blowing hazard.
Natural drainage is adequate	High available water capacity; moderately permeable.	Slopes of 1 to 12 percent.
Seasonal high water table; moderately permeable.	High available water capacity; moderately permeable; somewhat poorly drained.	Slopes of 0 to 4 percent; somewhat poorly drained.
Natural drainage is adequate	Medium available water capacity; moderately permeable.	Slopes of 2 to 20 percent; calcareous till at a depth of 20 to 40 inches.
High water table; moderately rapidly permeable; unstable when wet.	Very high available water capacity; moderately rapidly permeable; very poorly drained; soil blowing hazard.	Slopes of 0 to 2 percent; very poorly drained; organic material.

TABLE 11.—*Estimated engineering*

Soil series and map symbols	Soil features affecting—	
	Pond reservoir areas	Dikes, levees, and other embankments
Joy: JoA	Moderately permeable; seasonal high water table.	Medium shear strength; fair compaction
Kibbie: KbA	Moderately permeable; seasonal high water table.	Subsoil has medium shear strength, fair to good compaction. Substratum has low to medium shear strength, fair to poor compaction, piping hazard.
Knowles: KnB, KnC2, KnD2	Moderately permeable subsoil; fractured limestone bedrock at a depth of 20 to 40 inches.	Medium shear strength; fair to good compaction; substratum is limestone bedrock.
Lapeer: LaB, LaC2, LaD2, LaE2	Moderately permeable subsoil; moderately rapidly permeable substratum.	Medium shear strength; fair to good compaction; stones.
Lorenzo: LoB, LoC2, LoD2	Moderately permeable subsoil; rapidly to very rapidly permeable substratum.	Subsoil has medium shear strength, fair to good compaction. Substratum has high shear strength, good compaction.
Marcellon: MaB	Moderately permeable subsoil; moderately rapidly permeable substratum; seasonal high water table.	Medium shear strength; fair to good compaction; stones.
Marsh: Mb	Variable permeability; flooded most of the time.	Variable characteristics; flooded most of the time.
Marshan: Mc	Moderately permeable subsoil; rapidly permeable substratum; high water table.	Subsoil has medium shear strength, fair to good compaction. Substratum has medium shear strength, good compaction, piping hazard.
McHenry: MeB2, MeC2, MeD2	Moderately permeable subsoil; moderately rapidly permeable substratum.	Medium shear strength; fair to good compaction; stones.
Military: MnB, MnC2, MnD2	Moderately permeable subsoil; rapidly permeable, weakly to strongly cemented sandstone bedrock at a depth of 20 to 40 inches.	Medium shear strength; fair to good compaction; stones; sandstone bedrock at a depth of 20 to 40 inches.
Morroco: MoA	Rapidly permeable; seasonal high water table.	Medium shear strength; fair to good compaction; piping hazard.
Mt. Carroll: MrD2, MtA, MtB, MtC2	Moderately permeable subsoil; moderately slowly permeable substratum.	Subsoil has medium shear strength, fair compaction. Substratum has low to medium shear strength, fair to poor compaction, piping hazard.
Northfield: NoB, NoC, NoE	Moderately permeable subsoil; rapidly permeable, weakly to strongly cemented sandstone bedrock at a depth of 10 to 20 inches.	Medium shear strength; fair to good compaction; stones; substratum is sandstone bedrock.
Okee: OkB, OkC	Rapidly permeable in upper part of subsoil; moderately permeable in lower part of subsoil; moderately rapidly permeable substratum.	Subsoil has medium shear strength, fair to good compaction, piping hazard. Substratum has medium shear strength, fair to good compaction, stones.
Oshtemo: OmA, OmB, OmC2, OmD2	Moderately rapidly permeable subsoil; rapidly permeable substratum.	Medium shear strength; fair to good compaction; piping hazard.
Ossian: OsA	Moderately to moderately slowly permeable; high water table.	Medium shear strength; fair compaction
Otter: Ot	Moderately permeable; frequently flooded; high water table.	Low to medium shear strength; fair to poor compaction.
Palms: Pa	Moderately rapidly permeable subsoil; moderately slowly permeable substratum; high water table.	Subsoil is organic material and unsuitable. Substratum has low to medium shear strength; fair compaction.
Plainfield: PeC2, PfA, PfB, PfC, PfD	Rapidly permeable	Medium shear strength; good compaction; piping hazard.

interpretations for specified uses—Continued

Soil features affecting—Continued		
Drainage for crops and pasture	Irrigation	Terraces and diversions
Seasonal high water table; moderately permeable; ponding.	High available water capacity; moderately permeable; somewhat poorly drained.	Slopes of 0 to 4 percent; somewhat poorly drained.
Seasonal high water table; moderately permeable; unstable when wet.	High available water capacity; moderately permeable; somewhat poorly drained.	Slopes of 0 to 4 percent; somewhat poorly drained.
Natural drainage is adequate	Medium available water capacity; moderately permeable; bedrock at a depth of 20 to 40 inches.	Slopes of 2 to 20 percent; limestone bedrock at a depth of 20 to 40 inches.
Natural drainage is adequate	Medium available water capacity; moderately permeable; stones.	Slopes of 2 to 30 percent; calcareous till at a depth of 24 to 40 inches; stones.
Natural drainage is adequate	Low available water capacity; moderately permeable; sand and gravel at a depth of 12 to 24 inches.	Slopes of 2 to 20 percent; sand and gravel at a depth of 12 to 24 inches.
Seasonal high water table; moderately permeable subsoil; moderately rapidly permeable substratum.	Medium available water capacity; moderately permeable; somewhat poorly drained; stones.	Slopes of 1 to 6 percent; somewhat poorly drained; calcareous till at a depth of 20 to 40 inches.
Flooded most of the time; variable permeability.	Variable characteristics; flooded most of the time.	Flooded most of the time.
High water table; moderately permeable subsoil; rapidly permeable substratum is unstable when wet; ponding.	Medium available water capacity; moderately permeable; poorly drained; sand at a depth of 24 to 40 inches.	Slopes of 0 to 2 percent; poorly drained; sand at a depth of 24 to 40 inches.
Natural drainage is adequate	Medium available water capacity; moderately permeable.	Slopes of 2 to 20 percent; calcareous till at a depth of 24 to 40 inches.
Natural drainage is adequate	Medium available water capacity; moderately permeable; bedrock at a depth of 20 to 40 inches; stones.	Slopes of 2 to 20 percent; sandstone bedrock at a depth of 20 to 40 inches; stones.
Seasonal high water table; rapidly permeable; unstable when wet.	Low available water capacity; rapidly permeable; somewhat poorly drained; soil blowing hazard.	Slopes of 0 to 3 percent; somewhat poorly drained; sandy; difficult to vegetate; soil blowing hazard.
Natural drainage is adequate; ponding on MtA.	High available water capacity; moderately permeable.	Slopes of 0 to 20 percent.
Natural drainage is adequate	Low available water capacity; moderately permeable; bedrock at a depth of 10 to 20 inches; stones.	Slopes of 2 to 30 percent; sandstone bedrock at a depth of 10 to 20 inches; stones.
Natural drainage is adequate	Medium available water capacity; rapidly permeable over moderately permeable; soil blowing hazard.	Slopes of 2 to 12 percent; sandy; difficult to vegetate; soil blowing hazard; loamy material at a depth of 20 to 40 inches.
Natural drainage is adequate	Low available water capacity; moderately rapidly permeable; soil blowing hazard.	Slopes of 0 to 20 percent; sandy; difficult to vegetate in places; soil blowing hazard.
High water table; moderately to moderately slowly permeable; ponding.	High available water capacity; moderately to moderately slowly permeable; poorly drained.	Slopes of 0 to 3 percent; poorly drained.
High water table; moderately permeable; frequently flooded; ponding.	Very high available water capacity; moderately permeable; poorly drained; frequently flooded.	Slopes of 0 to 2 percent; poorly drained; frequently flooded.
High water table; moderately rapidly permeable subsoil; moderately slowly permeable substratum; subsoil is unstable when wet.	Very high available water capacity; moderately rapidly permeable; very poorly drained; soil blowing hazard.	Slopes of 0 to 2 percent; very poorly drained; organic material.
Natural drainage is excessive	Low available water capacity; rapidly permeable soil blowing hazard.	Slopes of 0 to 25 percent; sandy; difficult to vegetate; soil blowing hazard.

TABLE 11.—*Estimated engineering*

Soil series and map symbols	Soil features affecting—	
	Pond reservoir areas	Dikes, levees, and other embankments
PkB, PkC, PkD	Rapidly permeable subsoil; moderate to moderately rapid permeability in substratum.	Subsoil has medium shear strength, good compaction, piping hazard. Substratum has low to medium shear strength, poor to good compaction.
Plano: PnA, PnB, PnC2	Moderately permeable subsoil; moderately rapidly permeable substratum.	Medium shear strength; fair to good compaction; stones in substratum.
Poygan: PoA	Slowly permeable; high water table	Medium to low shear strength; fair to poor compaction; high shrink-swell potential.
Puchyan: PuB, PuC	Rapidly permeable in upper part of subsoil; moderately permeable in lower part of subsoil and substratum.	Subsoil has medium shear strength, fair to good compaction, piping hazard. Substratum has low to medium shear strength, fair compaction.
Ringwood: RdB2, RdC2	Moderately permeable subsoil; moderately rapidly permeable substratum.	Medium shear strength; fair to good compaction; stones.
Ripon: ReB, ReC2	Moderately permeable subsoil; fractured limestone bedrock at a depth of 20 to 40 inches.	Medium shear strength; fair to good compaction; limestone bedrock at a depth of 20 to 40 inches.
Rock land: Rk	Variable permeability; bedrock at or near the surface; too steep.	Variable characteristics; bedrock at or near the surface.
Rodman: RoC, RoD, RoE	Very rapidly permeable	High shear strength; good compaction
Rotamer: RtB, RtC2, RtD2, RtE2	Moderately permeable subsoil; moderately rapidly permeable substratum.	Medium shear strength; fair to good compaction; stones.
St. Charles: SaA, SaB2, SaC2, SaD2, SaE	Moderately permeable subsoil; moderately rapidly permeable substratum.	Medium shear strength; fair to good compaction; stones in substratum.
Salter: SbA, SbB, SbC2, SbD2	Moderately permeable	Low to medium shear strength; fair compaction; piping hazard.
Salter, variant: ScB	Moderately permeable	Low to medium shear strength; fair compaction; piping hazard.
Sandy land: Sd. No interpretations; material too variable. Onsite investigation needed.		
Saybrook: SeB2, SeC2, SeD2	Moderately permeable subsoil; moderately rapidly permeable substratum.	Medium shear strength; fair to good compaction; stones in substratum.
Seaton: SfA, SfB2, SfC2, SfD2	Moderately permeable	Medium shear strength; fair compaction
Sisson: SnA, SnB, SnC2, SnD2, SnE	Moderately permeable	Subsoil has medium shear strength, fair to good compaction. Substratum has low to medium shear strength, fair to poor compaction, piping hazard.
Sparta: SpB	Rapidly permeable	Medium shear strength; good compaction; piping hazard.
Troxel: TsA	Moderately permeable; subject to overwash.	Low to medium shear strength; fair to poor compaction.
Tustin: TuB	Rapidly permeable in upper part of subsoil; slowly permeable in lower part of subsoil and substratum.	Subsoil has medium shear strength, fair to good compaction, piping hazard. Substratum has low to medium shear strength, fair to poor compaction, high shrink-swell potential.
Tustin, variant: TvA	Rapidly permeable in upper part of subsoil; slowly permeable in substratum; seasonal high water table.	Subsoil has medium shear strength, fair to good compaction, piping hazard. Substratum has low to medium shear strength, fair to poor compaction, high shrink-swell potential.

interpretations for specified uses—Continued

Soil features affecting—Continued		
Drainage for crops and pasture	Irrigation	Terraces and diversions
Natural drainage is excessive	Low available water capacity; rapidly permeable; soil blowing hazard.	Slopes of 2 to 25 percent; sandy; difficult to vegetate; soil blowing hazard.
Natural drainage is adequate; ponding on PnA.	High available water capacity; moderately permeable.	Slopes of 0 to 12 percent.
High water table; slowly permeable; ponding.	High available water capacity; slowly permeable; poorly drained; slow water intake rate.	Slopes of 0 to 3 percent; poorly drained; clayey; difficult to work.
Natural drainage is adequate	Medium available water capacity; rapidly permeable subsoil over moderately permeable substratum; soil blowing hazard.	Slopes of 2 to 12 percent; sandy; difficult to vegetate; soil blowing hazard; silty material at a depth of 20 to 40 inches.
Natural drainage is adequate	Medium available water capacity; moderately permeable.	Slopes of 1 to 12 percent; calcareous till at a depth of 30 to 45 inches.
Natural drainage is adequate	Medium available water capacity; moderately permeable; bedrock at a depth of 20 to 40 inches.	Slopes of 2 to 12 percent; limestone bedrock at a depth of 20 to 40 inches.
Natural drainage is adequate	Variable available water capacity and permeability; bedrock at or near the surface; too steep.	Slopes of 12 to 75 percent; bedrock at or near the surface; rock outcrops.
Natural drainage is excessive	Very low available water capacity; very rapidly permeable; gravelly; sand and gravel at a depth of 5 to 8 inches.	Slopes of 2 to 45 percent; gravelly sand and gravel at a depth of 5 to 8 inches.
Natural drainage is adequate	Medium available water capacity; moderately permeable; stones.	Slopes of 2 to 30 percent; gravelly; calcareous till at a depth of 12 to 24 inches; stones.
Natural drainage is adequate; ponding on SaA.	High available water capacity; moderately permeable.	Slopes of 0 to 30 percent.
Natural drainage is adequate	Medium available water capacity; moderately permeable.	Slopes of 0 to 20 percent.
Natural drainage is adequate	Medium available water capacity; moderately permeable.	Slopes of 1 to 6 percent.
Natural drainage is adequate	High available water capacity; moderately permeable.	Slopes of 2 to 20 percent; calcareous till at a depth of 30 to 42 inches.
Natural drainage is adequate; ponding on SfA.	High available water capacity; moderately permeable.	Slopes of 0 to 20 percent.
Natural drainage is adequate	High available water capacity; moderately permeable.	Slopes of 0 to 30 percent.
Natural drainage is excessive	Low available water capacity; rapidly permeable; soil blowing hazard.	Slopes of 1 to 6 percent; sandy; difficult to vegetate; soil blowing hazard.
Natural drainage is adequate; subject to overwash; ponding.	Very high available water capacity; moderately permeable; subject to overwash.	Slopes of 0 to 3 percent; overwash hazard.
Natural drainage is adequate	Medium available water capacity; rapidly permeable over slowly permeable; soil blowing hazard.	Slopes of 2 to 6 percent; sandy; difficult to vegetate; soil blowing hazard; clayey material at a depth of 20 to 40 inches.
Seasonal high water table; rapidly permeable subsoil; slowly permeable substratum.	Medium available water capacity; rapidly permeable over slowly permeable; somewhat poorly drained; soil blowing hazard.	Slopes of 0 to 4 percent; somewhat poorly drained; sandy; difficult to vegetate; soil blowing hazard; clayey material at a depth of 20 to 40 inches.

TABLE 11.—*Estimated engineering*

Soil series and map symbols	Soil features affecting—	
	Pond reservoir areas	Dikes, levees, and other embankments
Wacousta: Wa	Slowly permeable; high water table	Low to medium shear strength; fair to poor compaction.
Wallkill: Wb	Moderately permeable subsoil; moderately rapidly permeable substratum; frequently flooded; high water table.	Low shear strength; fair to poor compaction; substratum is organic material and is unsuitable.
Wasepi: WcA	Moderately rapidly permeable subsoil; rapidly permeable substratum.	Medium shear strength; fair to good compaction; piping hazard.
Winneshiek: WnB, WnC2	Moderately permeable subsoil; fractured limestone bedrock at a depth of 20 to 40 inches.	Medium shear strength; fair to good compaction; stones; limestone bedrock at a depth of 20 to 40 inches.
Wyocena: WoB, WoC2, WoD2, WoE, WxB, WxC2, WxD2.	Moderately rapidly permeable subsoil; rapidly permeable substratum.	Medium shear strength; fair to good compaction; stones.
WyB, WyC2, WyD2, WyE	Moderately rapidly permeable subsoil; rapidly permeable, weakly to strongly cemented sandstone bedrock at a depth of 45 to 60 inches.	Medium shear strength; fair to good compaction; stones; sandstone bedrock at a depth of 45 to 60 inches.
Yahara: YaA	Moderately permeable; seasonal high water table.	Low to medium shear strength; fair compaction; piping hazard.

TABLE 12.—*Engineering*

[Tests performed by the State Highway Commission of Wisconsin in cooperation with the U.S. Department of Commerce, Bureau Officials (AASHTO) (*1*). Dashes indicate that no determination was made]

Soil name and location	Parent material	Depth from surface	Moisture-density data [1]	
			Maximum dry density	Optimum moisture
		In	*Lb/cu ft*	*Pct*
Dresden loam: SW¼SW¼ sec. 24, T. 13 N., R. 9 E. (coarser textured than modal profile).	Loamy outwash over sand and gravel	8–19 30–48	--- ---	--- ---
Lapeer fine sandy loam: NW¼SE¼ sec. 2, T. 10 N., R. 8 E. (modal profile).	Loamy glacial till	12–22 36–48	121 129	13 9
SE¼SW¼SE¼ sec. 33, T. 13 N., R. 9 E. (thick solum).	Loamy glacial till	17–24 45–58	--- ---	--- ---
NW¼SW¼ sec. 11, T. 11 N., R. 10 E. (loam surface layer).	Loamy glacial till	21–31 34–48	126 131	10 7
NE¼SW¼ sec. 5, T. 11 N., R. 9 E. (thick solum).	Loamy glacial till	20–30 41–48	--- ---	--- ---
Marshan loam: SW¼NE¼ sec. 28, T. 13 N., R. 7 E. (modal profile).	Loamy drift over sands	14–24 24–36	--- ---	--- ---
Puchyan loamy fine sand: SW¼NE¼ sec. 3, T. 10 N., R. 11 E. (modal profile).	Sandy drift over silt over till	40–53 80–90	--- ---	--- ---

interpretations for specified uses—Continued

Soil features affecting—Continued		
Drainage for crops and pasture	Irrigation	Terraces and diversions
High water table; slowly permeable; water ponds for long periods.	High available water capacity; slowly permeable; very poorly drained.	Slopes of 0 to 2 percent; very poorly drained; water ponds for long periods.
High water table; moderately permeable subsoil; moderately rapidly permeable substratum; substratum is unstable when wet; frequently flooded; ponding.	Very high available water capacity; moderately permeable; very poorly drained; frequently flooded.	Slopes of 0 to 2 percent; very poorly drained; frequently flooded; organic material at a depth of 24 to 40 inches.
Seasonal high water table; moderately rapidly permeable subsoil; rapidly permeable substratum is unstable when wet.	Low available water capacity; moderately rapidly permeable; somewhat poorly drained.	Slopes of 0 to 3 percent; somewhat poorly drained; sand at a depth of 20 to 40 inches.
Natural drainage is adequate	Medium available water capacity; moderately permeable; bedrock at a depth of 20 to 40 inches.	Slopes of 2 to 12 percent; limestone bedrock at a depth of 20 to 40 inches.
Natural drainage is adequate	Low available water capacity; moderately rapidly permeable; soil blowing hazard; stones.	Slopes of 2 to 45 percent; calcareous sandy till at a depth of 24 to 40 inches; stones.
Natural drainage is adequate	Low available water capacity; moderately rapidly permeable; bedrock at a depth of 45 to 60 inches.	Slopes of 2 to 45 percent; sandstone bedrock at a depth of 45 to 60 inches.
Seasonal high water table; moderately permeable; unstable when wet.	Medium available water capacity; moderately permeable; somewhat poorly drained.	Slopes of 0 to 4 percent; somewhat poorly drained.

test data

of Public Roads, in accordance with standard test procedures of the American Association of State Highway [and Transportation]

Mechanical analysis [2]										Liquid limit [3]	Plasticity index [4]	Classification	
Percentage less than 3 inches passing sieve—						Percentage smaller than—							
1 in	3/4 in	3/8 in	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05 mm	0.005 mm	0.002 mm			AASHTO [5]	Unified [6]
										Pct			
------	------	------	------	100	86	40	38	19	16	25	12	A-6(1)	SC
92	89	82	75	68	44	2	2	1	1	------	[7] NP	A-1-b(0)	SP
100	99	97	95	93	87	35	34	20	17	28	13	A-6(1)	SC
92	89	83	79	75	67	19	17	4	3	------	NP	A-2-4(0)	SM
------	------	------	------	100	96	48	47	23	19	28	14	A-6(4)	SC
92	88	85	83	81	72	20	18	6	5	------	NP	A-2-4(0)	SM
100	99	96	95	94	87	36	32	20	17	25	10	A-4(0)	SC
92	90	84	80	76	69	28	23	7	6	------	NP	A-2-4(0)	SM
98	96	94	94	92	86	37	33	19	17	27	12	A-6(0)	SC
95	91	86	82	79	71	22	17	6	4	------	NP	A-2-4(0)	SM
------	------	------	------	100	97	39	39	28	23	33	18	A-6(3)	SC
------	------	------	------	100	99	2	2	2	2	------	NP	A-3(0)	SP
------	------	------	------	100	99	91	88	29	23	35	14	A-6(10)	CL
98	95	90	86	82	72	20	17	8	6	------	NP	A-2-4(0)	SM

TABLE 12.—*Engineering*

Soil name and location	Parent material	Depth from surface	Moisture-density data [1]	
			Maximum dry density	Optimum moisture
NE¼SE¼ sec. 34, T. 11 N., R. 12 E. (no silt in C horizon).	Sandy drift over silt over till	30–42 55–70	---------- ----------	---------- ----------
NE¼SE¼ sec. 7, T. 11 N., R. 12 E. (no silt in C horizon).	Sandy drift over silt over till	41–50 50–100	114 141	16 7
Wyocena loamy sand: SE¼SW¼ sec. 36, T. 12 N., R. 9 E. (modal profile).	Sandy till	14–23 32–60	---------- 131	---------- 7

[1] Based on AASHTO Designation: T 99–57, Method A (*1*).
[2] Mechanical analysis according to the AASHTO Designation T 88–57 (*1*). Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHTO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material up to and including that 3 inches in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for use in naming textural classes for soil.
[3] Based on AASHTO Designation: T 89–60 (*1*).

Depth to bedrock is the distance, in inches, from the surface of the soil to the upper surface of the rock layer. The map "Distribution of Bedrock Soils" (fig. 22) shows the areas in the county where bedrock is at a depth of less than 40 inches. These areas make up about 6 percent of the county or 29,100 acres. The map also shows those parts of the county where the underlying bedrock is limestone, sandstone, or quartzite. Soils underlain by limestone bedrock, mainly in the eastern and southern parts of the county, are a good source of limestone for crushing. Many quarries are located in these soils. Soils underlain by sandstone bedrock are mainly in the west-central, central, and north-central parts of the county. Soils underlain by quartzite bedrock, mainly in the western part of the county on the Baraboo Bluffs, are a good source of quartzite for use as abrasive material.

Depth to seasonal high water table refers to the distance from the surface of the soil to the highest level that ground water stands for a significant period. Ordinarily, free water stands at this level in spring or during a prolonged wet period. The depth to water table is related to the natural drainage of the soils as follows: 0 to 1 foot, *poorly drained or very poorly drained;* 1 to 3 feet, *somewhat poorly drained;* more than 3 feet, *moderately well drained to excessively drained.*

During the period from May 1, 1969, to December 1, 1971, depth to the water table was measured on the first of each month in four somewhat poorly drained sandy soils and in a poorly drained Marshan soil. The measurements were taken at the same sites each time. During this period, the depth from the surface of the soil to the water table fluctuated from about 20 inches to 75 inches in the somewhat poorly drained soils and from 0 inches (water table at the surface) to about 60 inches in the poorly drained soil. The water table was at its highest level in April and at its lowest level in September. It was also noted that the water table remained at a fairly stable level throughout the winter; it rose early in spring, early in summer, and late in fall; and it fell late in spring and late in summer. Therefore, it can be assumed that the values in table 9 for depth to seasonal high water table are most accurate during April, the early part of May and the last part of June.

The dominant USDA texture and the Unified and AASHTO classifications are shown in table 9 for each of the major soil horizons. Also shown are the estimated percentages of material passing through the various sieves. These estimates are based on the assumption that material up to and including 3 inches in diameter equals 100 percent.

Soil *permeability* is the quality that enables a soil to transmit water and air. Accepted as a measure of this quality is the rate at which soil transmits water while saturated. Permeability is estimated on the basis of those soil characteristics observed in the field, particularly structure and texture. The estimates in table 9 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts. The basis for estimating permeability is defined in the Glossary.

Available water capacity is the ability of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most crop plants.

Reaction is the degree of acidity or alkalinity of a soil, expressed in pH value. A pH of 7.0 is neutral; values of less than 7.0 indicate acidity; and values of more than 7.0 indicate alkalinity. The pH value and terms used to describe soil reaction are explained fully in the Glossary.

Shrink-swell potential is the relative change in volume to be expected of soil material with changes in moisture content; that is, the extent to which the soil shrinks as it dries out or swells when it gets wet. Build-

test data—Continued

Mechanical analysis[2]										Liquid limit[3]	Plasticity index[4]	Classification	
Percentage less than 3 inches passing sieve—						Percentage smaller than—							
1 in	3/4 in	3/8 in	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05 mm	0.005 mm	0.002 mm			AASHTO[5]	Unified[6]
------	------	------	------	100	99	90	86	30	24	36	15	A-6(10)	CL
96	93	87	83	80	71	44	38	10	6	------	NP	A-4(2)	SM
------	------	------	------	100	99	96	93	27	20	31	10	A-4(8)	CL
95	94	88	83	79	72	44	38	12	7	15	2	A-4(2)	SM
------	------	------	------	100	95	25	22	13	11	------	NP	A-2-4(0)	SM
97	94	89	86	84	77	24	21	9	7	------	NP	A-2-4(0)	SM

[4] Based on AASHTO Designation: T 90–56 and AASHTO Designation: T 91–54 (*1*).
[5] Based on AASHTO Designation: M 145–49 (*1*).
[6] Based on ASTM Designation: D 2487–66 T (*2*).
[7] Nonplastic.

ing foundations, roads, and other structures can be severely damaged by the shrinking and swelling of soil. Extent of shrinking and swelling is influenced by the amount of moisture change and the amount and kind of clay in the soil. A rating of *high* indicates a hazard to maintenance of structures built in, on, or with material having this rating.

Corrosion, as used in table 9, pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to soil properties such as drainage, texture, total acidity, resistance to flow of electrical current, and conductivity of saturation extract. The probability of corrosion is greater for extensive installations that intersect soil boundaries or soil horizons than for installations that remain in one kind of soil or in one soil horizon. Construction, paving, fill and compaction, surface additions, or excavations that alter the soil or result in aeration and in nonuniform mixing of soil horizons may accelerate the problem of corrosion. Corrosion for concrete is influenced mainly by the amount of sulfates and soil acidity and texture. Generally concrete corrodes more rapidly in the more acid soils. A rating of *low* indicates a low probability of soil-induced corrosion damage. A rating of *high* indicates a high probability of damage. Accordingly protective measures for steel and more resistant concrete are essential in avoiding or minimizing damage.

Engineering interpretations

Interpretations in tables 10 and 11 are based on the estimates of properties of soils shown in table 9, on test data for soils in this survey area and others nearby or adjoining, and on the experience of engineers and soil scientists with the soils of Columbia County (*21*). Table 10 rates the limitation or suitability of the soils for all listed purposes. Table 11 lists those soil features not to be overlooked in planning, installing, and maintaining drainage for crops and pasture, irrigation, ponds and reservoirs, embankments, and terraces and diversions.

Soil limitations are expressed as slight, moderate, and severe. *Slight* means that soil properties are generally favorable for the rated use, or in other words, limitations are minor and easily overcome. *Moderate* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. *Severe* indicates soil properties so unfavorable and so difficult to correct or overcome that major soil reclamation, special design, or intensive maintenance is required.

Soil suitability is expressed as good, fair, and poor, which have, respectively, meanings approximately parallel to the terms slight, moderate, and severe.

The terms, "high water table" and "seasonal high water table," used in tables 10 and 11 correspond to the depth to water tables as follows: 0 to 1 foot, *high water table;* 1 foot to 5 feet, *seasonal high water table.* Depths refer to the distance from the surface of the soil to the highest level that ground water stands for a significant period, generally in spring.

The term *stones* is used to connote the presence of stones in the material. It refers to a USDA class of stoniness of 0 or 1, whereby stones, more than 10 inches in diameter, occupy less than 0.1 percent of the area. All of the glacial till in the survey area contains some stones, and many of the soils formed wholly or partly in this till.

Following are explanations of some of the columns in tables 10 and 11.

Septic tank absorption fields are subsurface systems of tile or perforated pipe, generally at a depth of about 2 feet, that distribute effluent from a septic tank into natural soil. The soil material is evaluated from a depth of about 18 inches to 5 feet. The soil properties considered are those that affect both absorption of effluent and construction and operation of the system. Properties that affect absorption are permeability, depth

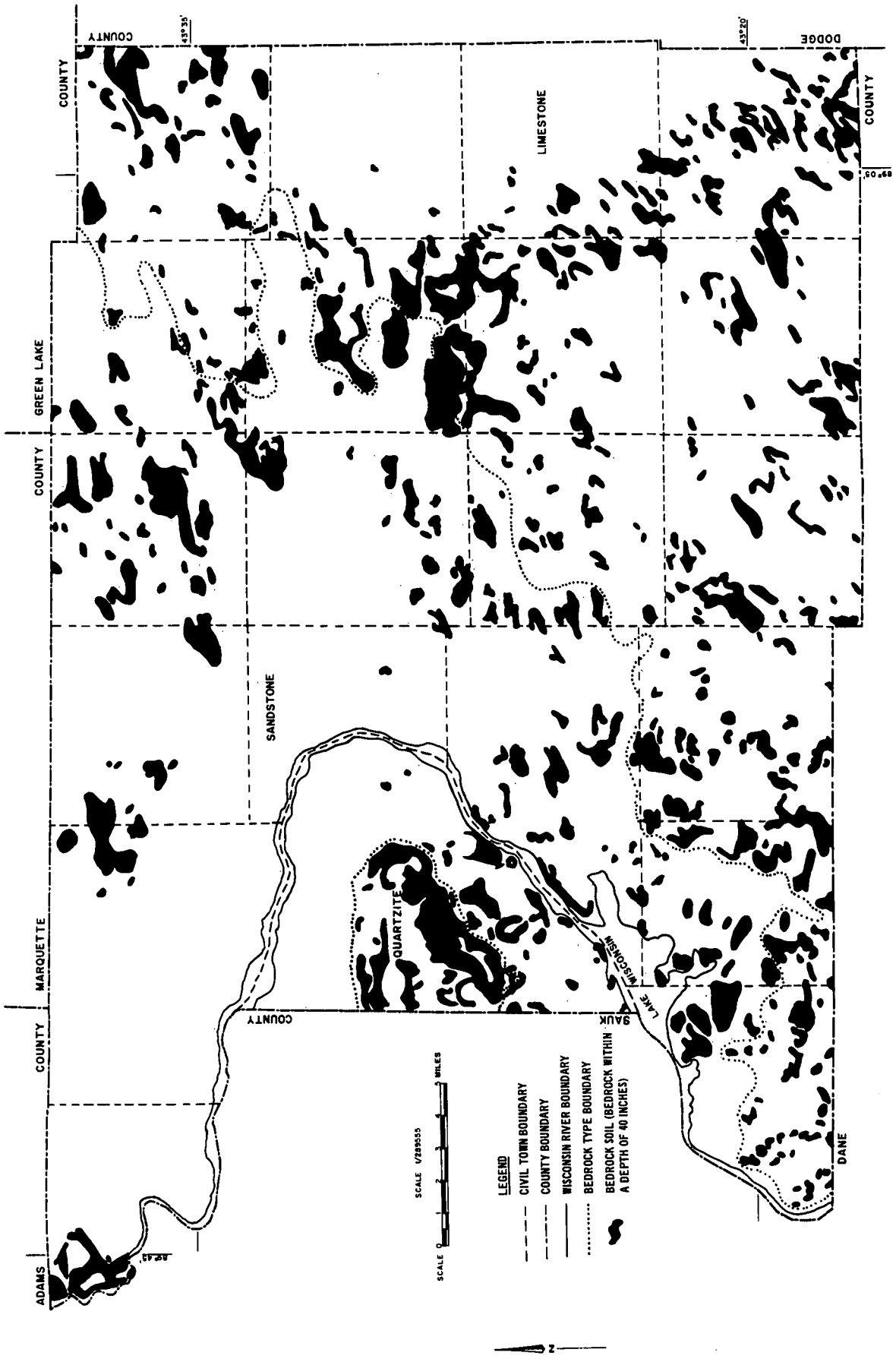

Figure 22.—Distribution of soils that have bedrock within a depth of 40 inches.

to water table or bedrock, and susceptibility to flooding. Slope is a soil property that affects difficulty of layout and construction and also the risk of soil erosion, lateral seepage, and downslope flow of effluent. Stones increase construction costs. It should be noted that although soils have rapid permeability and only slight limitations, contamination can be a hazard if water supplies, streams, ponds, lakes, or watercourses are nearby and receive seepage from the absorption field. Also, contamination is a hazard in soils underlain by limestone bedrock. The limestone in the survey area is commonly fractured and creviced and permits unfiltered sewage to travel long distances through aquifers.

Sewage lagoons are shallow ponds constructed to hold sewage within a depth of 2 to 5 feet long enough for bacteria to decompose the solids. A lagoon has a nearly level floor, and sides, or embankments, of compacted soil material. The assumption is made that the embankment is compacted to medium density and the pond is protected from flooding. Properties are considered that affect the pond floor and the embankment. Those that affect the pond floor are permeability, organic matter, and slope. If the floor needs to be leveled, depth to bedrock is important. The soil properties that affect the embankment are the engineering properties of the embankment material as interpreted from the Unified Soil Classification and the number of stones, if any, that influence the ease of excavation and compaction of the embankment material.

Shallow excavations require digging or trenching to a depth of less than 6 feet, as for example excavations for pipelines, sewer lines, phone and power transmission lines, basements, open ditches, and cemeteries. Desirable soil properties are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrops or big stones, and freedom from flooding or a high water table.

Dwellings with basements, as rated in table 10, are no more than three stories high and are supported by foundation footings placed in undisturbed soil. It is assumed that in this survey area the footings will be placed below the frost line, at a depth of 4 feet or more. Therefore, the ratings are based mainly on the characteristics of the substratum material, and susceptibility to frost action is disregarded. Features that affect the rating of a soil relate to capacity to support load and resist settlement under load and to ease excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones.

Sanitary landfill is a method of disposing of refuse in dug trenches. The waste is spread in thin layers, compacted, and covered with soil throughout the disposal period. Landfill areas are subject to heavy vehicular traffic. Some soil properties that affect suitability for landfill are ease of excavation, hazard of polluting ground water, and trafficability. The best soils have moderately slow permeability, withstand heavy traffic, and are friable and easy to excavate. Unless otherwise stated, the ratings in table 10 apply only to a depth of about 5 feet. Therefore limitation ratings of *slight* or *moderate* may not be valid if trenches are to be much deeper than that. For some soils, reliable predictions can be made to a depth of 10 or 15 feet, but regardless of that, every site should be investigated before it is selected.

Local roads and streets, as rated in table 10, have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base consisting of gravel, crushed rock, or soil material stablized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. These roads are graded to shed water and have ordinary provisions for drainage (fig. 23). They are built mainly from soil at hand, and most cuts and fills are less than 5 feet deep.

Soil properties that most affect design and construction of roads and streets are load supporting capacity and stability of the subgrade, and the workability and quantity of cut and fill material available. The AASHTO and Unified classifications of the soil material, and also the shrink-swell potential, indicate traffic-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth of bedrock, content of stones, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade.

Road fill is soil material used in embankments for roads. The ratings reflect how well a soil performs after it is removed from its original location and is placed in a road embankment elsewhere. They also reflect evaluation of soil characteristics, such as slope, that determine the ease or difficulty in excavating the material at borrow areas. The ratings are based on the soil material at a depth of about 1 to 5 feet, and it is assumed that this material will be mixed. More suitable material at a greater depth is possible.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 10 provide guidance about where to look for probable sources. A soil rated as a *good* or *fair* source of sand or gravel generally has a layer at least 3 feet thick, the top of which is within a depth of 5 feet. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the materials; nor do they indicate quality of the deposit.

Topsoil is used in topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as in preparing a seedbed; natural fertility of the material, or its response of plants when fertilizer is applied; and absence of substances toxic to plants. Texture of the soil material and its content of stone fragments are characteristics that affect suitability, but also considered in the ratings is damage that will result at the area from which topsoil is taken.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material. Additional information on the feasibility of dugout ponds can be found in the section "Soils and Wildlife."

Figure 23.—**Subgrade failure on Alluvial land, loamy, wet. Wetness and flooding affect the stability of this material.**

Embankments, dikes, and levees require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, and compactibility. Presence of stones or organic material in a soil are among factors that are unfavorable. As used in table 11, the term "piping" refers to a medium or high hazard of piping.

Drainage of crops and pasture is affected by such soil properties as permeability, texture, and structure; depth to claypan, rock, or other layers that influence rate of water movement; depth to the water table; slope; stability in ditchbanks; susceptibility to stream overflow; and availability of outlets for drainage.

Irrigation of a soil is affected by such features as slope; susceptibility to stream overflow, water erosion, or soil blowing; soil texture; content of stones; accumulations of salts and alkali; depth of root zone; rate of water intake at the surface; permeability of soil layers below the surface layer and in fragipans or other layers that restrict movement of water; amount of water held available to plants; and need for drainage, or depth to water table or bedrock. Most of the soils in the survey area have a moderate or high water intake rate.

Terraces and diversions are embankments, or ridges, constructed across the slope to intercept runoff so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock or other unfavorable material; presence of stones; permeability; and resistance to water erosion, soil slipping, and soil blowing. A soil suitable for these structures provides outlets for runoff and is not difficult to vegetate. Features that affect suitability of a soil for grassed waterways are similar to those that affect suitability for terraces and diversions.

Soil test data

Table 12 contains engineering test data for some of the more extensive soil series in Columbia County. Soil samples from major horizons of soils were taken at representative locations and were tested by the State Highway Commission of Wisconsin under a cooperative agreement with the U.S. Department of Commerce, Bureau of Public Roads. These samples were tested in accordance with the standards procedures of AASHTO (*1*) to help evaluate the soils for engineering purposes.

The table gives maximum dry density and optimum moisture values for some of the tested soils. The density to which a soil can be compacted is an important en-

gineering property. In general, the greater the density, the greater the stability or strength of the material. For a given compactive effort the attainable density varies somewhat according to the moisture content, and that content at which the *maximum dry density* is attained is termed "the *optimum moisture content*" for that particular compactive effort. As a rule, optimum stability is obtained if the soil is compacted to about the maximum dry density when it is at approximately the optimum moisture content.

The engineering classifications given are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits. Mechanical analyses are made by combined sieve and hydrometer methods to determine the relative proportions of the different sized particles that make up the soil sample. The percentage of fine-grained material, obtained by the hydrometer method, ordinarily should not be used in determining soil textural classes.

Tests to determine liquid limit and plastic limit measure the effect of water on consistence of the soil material. If water is added to a dry soil containing at least some clay and silt, the moisture content increases to a point at which the material changes from a semisolid to a plastic state. The moisture content at which the soil becomes plastic is the *plastic limit.* As the moisture content is further increased, the material changes from a plastic to a liquid state. The moisture content at which the soil passes from a plastic to a liquid state is the *liquid limit.* The *plasticity index* is the difference between the liquid limit and the plastic limit. It indicates the range in moisture content over which the soil is plastic. Some soils, particularly very sandy soils, are not plastic and accordingly do not have a plasticity index. For such soils "NP," meaning nonplastic, is entered in the column.

Several systems of classifying soils for engineering purposes are in use. In table 12, classifications in two of these systems, the AASHTO and the Unified are listed for horizons of the tested soil samples.

Formation and Classification of the Soils

This section describes the factors of soil formation and tells how these factors have affected the soils in Columbia County. It also explains the system of soil classification currently used and classifies each soil series recognized in the county according to that system.

Factors of Soil Formation

Soil is produced by soil-forming processes acting on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material *(20),* (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of soil formation have acted on the soil material.

The physical, chemical and biological reactions resulting from the interaction of these factors of soil formation occur in such soil-forming processes as *accumulation* of organic matter in the surface layer, *transformation* of soil material, and the *removal, transfer,* and *deposition* of soil components from one part of the soil profile to another.

The results of the soil-forming processes can readily be seen in the Dodge soils. The parent material of these soils was calcareous sandy loam till and windblown silt. The silt was deposited over the till. The gently sloping to moderately steep relief influenced the other factors of soil formation; for example, it contributed to the characteristics that make these soils well drained and affected the amount of water available for percolation. The temperate climate and rainfall affected the formation and decomposition of organic matter. Minerals were dissolved and moved in solution downward in the soil profile. Plants and animals contributed to the accumulation of organic matter and organic acids, mixed the soil to some extent, and also hastened the downward movement of water in the soil profile. In time, these processes were accelerated.

Free lime in the soil material gradually dissolved and was moved downward by percolating waters. As a result, Dodge soils have an acid profile, and the material immediately below the profile is calcareous. Also moving downward were acids that reacted with rock and mineral constituents to form secondary clay minerals. These suspended particles of clay were also translocated. As a result, the lower part of the silty layer and the upper part of the glacial till in the Dodge soil contain more clay than other parts of the profile. While clay and dissolved lime were being moved downward, organic matter in various stages of decomposition was accumulating on and in the surface layer and darkening that layer.

As a result of these soil-forming processes, the surface layer in Dodge soils is very dark grayish-brown silt loam, the upper part of the subsoil is silty clay loam, and the lower part of the subsoil is sandy clay. At a depth of about 39 inches is the unweathered, calcareous sandy loam glacial till that has changed little since it was deposited.

In varying degrees, the soil-forming processes are occurring in all the soils of Columbia County. The kinds of parent material and the relief, or topography, have, to a great extent, determined the kinds of processes that have been dominant in the formation of all the soils. Factors that have contributed to the soil-forming processes are described in more detail in the following paragraphs.

Parent material

Most of the soils of Columbia County formed wholly or partly in material laid down by glaciers or in windblown material, such as loess. Some formed in organic material or alluvium.

Columbia County was glaciated by the Green Bay Glacier during the Wisconsin stage of glaciation. Ice came into the county from the northwest and moved slowly in a general westerly and southwesterly direction. The glacial material left in this area after the ice melted was derived mainly from the local bedrock formations and material deposited during previous gla-

ciations. A significant part, however, mainly the crystalline material, was transported into the county from considerable distances. The glacial debris, or drift, commonly ranges from a few feet to tens of feet in thickness and, in places, is several hundred feet thick.

Sandstone and limestone are the main kinds of bedrock underlying the glacial material. Quartzite underlies the drift in a small area to the west, locally known as the Baraboo Bluffs. As shown on the map, "Distribution of Bedrock Soils" (fig. 22), the glacial material is less than 40 inches thick over bedrock in many small areas in the county. Limestone underlies the glacial material in the eastern and southern parts of the survey area.

After the glacial ice melted, deposits of till, outwash, and lacustrine material remained. Of these deposits, glacial till, consisting of poorly sorted, crushed, and mixed material, is most common in the survey area. About 240,000 acres of soil in the survey area formed wholly or partly in glacial till. The till is finest in texture, heavy sandy loam, and more calcareous in the eastern part of the county. As one proceeds west it generally becomes coarser textured and less calcareous and increases in the proportion of sandstone to limestone in the gravel fraction. Till in the western part of the survey area is the coarsest textured, sand or light loamy sand, and the least calcareous. The content of gravel in the till is fairly uniform throughout the survey area, but the kinds of gravel are highly variable. The gravel in the till in the eastern part of the county is mostly dolomitic material mixed with some crystalline material. As one proceeds west across the county, the till contains fewer dolomitic pebbles and more sandstone pebbles. Also, the coarser textured tills in the western part of the county are redder in color. The finer textured till was the parent material of Griswold soils, for example. Lapeer and Wyocena soils formed in the coarser textured till.

About 60,000 acres of soils in the county formed wholly or partly in glacial outwash material. The outwash consists of varying amounts of well-rounded pebbles, cobblestones, and sand that were deposited by moving water as the glacier melted. The flowing water carried away the finer particles and tended to sort the coarser material. Boyer, Dresden, and Rodman soils formed in this glacial outwash, which is mostly in the central and western part of the survey area.

About 40,000 acres of soils, Colwood and Poygan soils, for example, formed in lacustrine material deposited by the very slowly moving or ponded waters of temporary glacial lakes. This material consists of thin layers of clay, silt, very fine sand, and fine sand. A large part was deposited in a large glacial lake in the northwestern part of the county.

Soils, such as Plano and St. Charles soils, that formed wholly or partly in loess occupy about 200,000 acres of the survey area. Most of the eastern and southern parts of the county are covered by loess that ranges from a few inches to more than 5 feet in thickness. This loess, or silt, is generally underlain by glacial till material. Therefore, most of the soils that formed in loess also formed partly in the underlying till.

A mixed, windblown deposit of silt and fine sand occurs along the fringe areas of silt deposits. In many places, the material was deposited as well-sorted, alternating layers of silt and very fine sand. Many of the Salter and Sisson soils formed in these deposits. Friesland and Grellton soils formed in areas where silt deposits were later covered by mixed, windblown deposits of silt and fine sand.

Windblown deposits of sand also occur in the survey area. In many places, this sandy material was deposited over earlier deposits of different material, such as glacial till. Okee, Chelsea, and Puchyan soils formed in these areas.

During the postglacial period, many shallow lakes and waterways in the area were favorable places for the growth of aquatic plants. About 43,000 acres of the organic Adrian, Boots, Houghton, and Palms soils formed in the decomposed remains of these aquatic plants. In places, these deposits of decomposed organic remains are 20 or more feet thick.

About 26,000 acres of soils formed in recent alluvium. In some areas, this sediment consists mostly of silt eroded from the adjoining uplands, such as in the Troxel soils. Along the Wisconsin River, this sediment consists of distinct layers of sandy and loamy material. Alluvial land, loamy, is an example of this type of deposit. Generally, deposition of this material is too recent for distinct soil horizons to have developed.

Climate

Columbia County has the cool, subhumid, continental climate characteristic of the north-central part of the United States. The climate is modified locally by variations in relief and aspect, but these differences are too small to have caused any major differences in the soils. Precipitation and temperature are the chief factors that determine features of the soil. They affect the amount of water available for percolation and the formation and decomposition of organic matter, both of which are major processes in the formation of the soils.

Rainwater and the thawing waters of the snow act directly and indirectly on the formation of the soil through solution and hydration on mineral matter and on substances of organic nature. The amount of percolating water available controls the distribution of substances through the profile. Moisture is also one of the determining factors in plant growth and subsequent accumulation of organic matter in the surface layer of a soil. Columbia County receives about 31 inches of rainfall yearly.

In two different isothermal belts under the same amount of precipitation, different soil profiles form as a result of the differing temperatures. A frozen layer in soil, caused by low temperature, is unfavorable for percolation of water. In Columbia County, the soils have a seasonal frozen layer that modifies the activity of the factors of soil formation. High temperatures in summer cause increased evaporation and transpiration of moisture out of the soil, which impedes the leaching affects of percolating water. Temperature also affects the formation and decomposition of organic matter. A larger amount of organic matter accumulates in cooler climates. Frost heaving in the soil also affects formation of the soil profile.

Wind carries off fine particles of soil material and indirectly affects the moisture content of soil by influencing the evaporation. Most of the sandy soils in the survey area are subject to blowing.

Plants and animals

Plants act directly and indirectly as a factor of soil formation. Their direct activity consists of their roots penetrating the soil body where they act mechanically on the rock and mineral material and serve as channels for drainage. Roots excrete a number of acid substances that act on rocks and minerals and bring certain constituents into solution. At the same time, roots absorb mineral substances and translocate them to the stems and leaves. When the plants die, minerals are released and organic and inorganic acids form.

Plants also affect the climate. For example, forests tend to make the climate milder. They reduce the force of winds, thereby regulating to a certain extent the evaporation rate.

The type of vegetation, grasses or trees, also influences the soil profile. A larger amount of organic matter accumulates under grasses than under forest vegetation, and the humus contributes to the darker color of grassland soils. Plano and Saybrook soils, for example, formed under grass. In contrast, Lapeer and McHenry soils formed under trees. They have a lighter colored surface layer and are generally more acid. Also organic matter decomposes more rapidly in soils that formed under trees.

Worms and other small animals dig into the soil, mix the material of the different horizons, and thus disturb the soil profile. They create channels, carry down organic matter from the surface layer, affect soil structure, help in decomposing organic matter, and carry material from lower to higher levels.

Man's activities have affected the features of the soil profile. He has felled the forests, burned the sod, lowered the water table, irrigated, cultivated, and fertilized. Many effects are detrimental. Many are beneficial.

Relief and drainage

Differences in relief in Columbia County are closely related to differences in drainage, runoff, and the degree of erosion of the soils. As an example, Sisson, Kibbie, and Colwood soils all formed in stratified deposits of silt and fine sand. Sisson soils generally occur at the higher elevations on the landscape, and they typically are gently sloping and well drained. Kibbie soils, on foot slopes, are nearly level to gently sloping and somewhat poorly drained. They have slow runoff, but receive some runoff from adjacent higher areas. They have grayish mottles at a depth of about 1 to 3 feet; the mottling indicates that they are saturated with water in this zone for significant periods of the year. Colwood soils are in low areas where the water table is near the surface most of the time. They are poorly drained. Runoff is very slow to ponded. The grayish colors in the profile indicate excessive moisture and poor aeration.

Generally the steeper soils are the more eroded. Erosion removes products of weathering that contribute to the formation of the soil profile. Runoff is rapid, and less water percolates down through the soil. As a result, the steeper soils are generally the shallower.

Slope exposure is another feature of the effects of topography on soil formation. In general, southern exposures are warmer and drier than northern exposures. Thus, the exposure affects the amount of water available for percolation and the accumulation of organic matter. As a result, the soil-forming processes occur at a slower rate on a southern exposure.

Time

Time is one of the most important factors in all processes. The degree of soil profile formation depends on the length of time the soil-forming processes have been active. Many of the alluvial soils in Columbia County, for example, do not have distinct horizons because the soil material has not been in place long enough for the formation of distinct horizons. Otter and Wallkill soils are examples of young soils. On the other hand, soils such as Lapeer soils, that formed in older glacial till, have well-defined horizons as the result of processes that have been active for thousands of years.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics (*16*). Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas such as countries and continents.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965 (*18*). Because this system is under continual study, readers interested in developments of the current system should search the latest literature available.[6]

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measureable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped. In table 13, the soil series of Columbia County are classified in four categories of the current system. Classes of the current system are briefly defined in the following paragraphs.

[6] See the unpublished working document "Selected Chapters from the Unedited Text of the Soil Taxonomy," available in the SCS State Office, Madison, Wis.

TABLE 13.—*Classification of soil series by higher categories*

[Classification current as of February 1, 1972]

Series	Family	Subgroup	Order
Adrian	Sandy or sandy-skeletal, mixed, euic, mesic	Terric Medisaprists	Histosols.
Atterberry [1]	Fine-silty, mixed, mesic	Udollic Ochraqualfs	Alfisols.
Baraboo	Fine-silty, mixed, mesic	Typic Hapludalfs	Alfisols.
Barry [1]	Fine-loamy, mixed, mesic	Typic Argiaquolls	Mollisols.
Boone	Mesic, uncoated	Typic Quartzipsamments	Entisols.
Boots	Euic, mesic	Typic Medihemists	Histosols.
Boyer [1]	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Briggsville [1]	Fine, mixed, mesic	Typic Hapludalfs	Alfisols.
Briggsville, variant	Fine-silty, mixed, mesic	Typic Hapludalfs	Alfisols.
Channahon	Loamy, mixed, mesic	Lithic Argiudolls	Mollisols.
Chelsea [1]	Mixed, mesic	Alfic Udipsamments	Entisols.
Colwood [1]	Fine-loamy, mixed, mesic	Typic Haplaquolls	Mollisols.
Dodge [1]	Fine-silty, mixed, mesic	Typic Hapludalfs	Alfisols.
Dresden	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Mollic Hapludalfs	Alfisols.
Friesland	Fine-loamy, mixed, mesic	Typic Argiudolls	Mollisols.
Gilford	Coarse-loamy, mixed, mesic	Typic Haplaquolls	Mollisols.
Granby	Sandy, mixed, mesic	Typic Haplaquolls	Mollisols.
Grellton	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Grellton, variant	Fine-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Griswold	Fine-loamy, mixed, mesic	Typic Argiudolls	Mollisols.
Houghton	Euic, mesic	Typic Medisaprists	Histosols.
Joy	Fine-silty, mixed, mesic	Aquic Hapludolls	Mollisols.
Kibbie [1]	Fine-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Knowles	Fine-silty, mixed, mesic	Typic Hapludalfs	Alfisols.
Lapeer	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Lorenzo	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Typic Argiudolls	Mollisols.
Marcellon	Fine-loamy, mixed, mesic	Aquic Argiudolls	Mollisols.
Marshan [1]	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Typic Haplaquolls	Mollisols.
McHenry	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Military	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Morocco	Mixed, mesic	Aquic Udipsamments	Entisols.
Mt. Carroll [1]	Fine-silty, mixed, mesic	Mollic Hapludalfs	Alfisols.
Northfield [1]	Loamy, mixed, mesic	Lithic Hapludalfs	Alfisols.
Okee	Loamy, mixed, mesic	Arenic Hapludalfs	Alfisols.
Oshtemo [1]	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Ossian [1]	Fine-silty, mixed, mesic	Typic Haplaquolls	Mollisols.
Otter	Fine-silty, mixed, mesic	Cumulic Haplaquolls	Mollisols.
Palms	Loamy, mixed, euic, mesic	Terric Medisaprists	Histosols.
Plainfield [1]	Mixed, mesic	Typic Udipsamments	Entisols.
Plano	Fine-silty, mixed, mesic	Typic Argiudolls	Mollisols.
Poygan	Fine, mixed, mesic	Typic Haplaquolls	Mollisols.
Puchyan	Loamy, mixed, mesic	Arenic Hapludalfs	Alfisols.
Ringwood	Fine-loamy, mixed, mesic	Typic Argiudolls	Mollisols.
Ripon [1]	Fine-silty, mixed, mesic	Typic Argiudolls	Mollisols.
Rodman [1]	Sandy-skeletal, mixed, mesic	Typic Hapludolls	Mollisols.
Rotamer [1]	Fine-loamy, mixed, mesic	Typic Argiudolls	Mollisols.
St. Charles [1]	Fine-silty, mixed, mesic	Typic Hapludalfs	Alfisols.
Salter [1]	Coarse-loamy, mixed, mesic	Typic Eutrochrepts	Inceptisols.
Salter, variant	Coarse-loamy, mixed, mesic	Typic Hapludolls	Mollisols.
Saybrook [1]	Fine-silty, mixed, mesic	Typic Argiudolls	Mollisols.
Seaton	Fine-silty, mixed, mesic	Typic Hapludalfs	Alfisols.
Sisson [1]	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Sparta	Sandy, mixed, mesic	Entic Hapludolls	Mollisols.
Troxel	Fine-silty, mixed, mesic	Typic Argiudolls	Mollisols.
Tustin	Clayey, mixed, mesic	Arenic Hapludalfs	Alfisols.
Tustin, variant	Fine-loamy, mixed, mesic	Aquic Arenic Hapludalfs	Alfisols.
Wacousta [1]	Fine-silty, mixed, mesic	Typic Haplaquolls	Mollisols.
Wallkill [1]	Fine-loamy, mixed, nonacid, mesic	Thapto-Histic Fluvaquents	Entisols.
Wasepi [1]	Coarse-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Winneshiek [1]	Fine-loamy, mixed, mesic	Mollic Hapludalfs	Alfisols.
Wyocena	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Yahara [1]	Coarse-loamy, mixed, mesic	Aquic Hapludolls	Mollisols.

[1] Taxadjunct to the series. See series description for taxadjunct characteristics.

ORDER. Ten soil orders are recognized. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this are the Entisols and Histosols, which occur in many different climates. Each order is named with a word of three or four syllables ending in *sol* (Ent-i-sol). Table 13 shows that the five soil orders in Columbia County are Entisols, Inceptisols, Mollisols, Alfisols, and Histosols.

Entisols are recent mineral soils that are without genetic horizons or that have only very weakly expressed beginnings of such horizons.

Inceptisols are mineral soils in which horizons have started to form, but these soils do not contain an accumulation of illuvial clay.

Mollisols are mineral soils that have a thick, dark-colored surface layer and a base saturation of more than 50 percent.

Alfisols are mineral soils that have horizons of clay accumulation and a base saturation of more than 35 percent. Unlike the Mollisols, they lack a thick, dark-colored surface layer.

Histosols are organic soils that are saturated for prolonged periods unless they have been artificially drained, and half or more of the upper 32 inches is organic material.

SUBORDER. Each order is divided into suborders, based primarily on those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging, or soil differences resulting from the climate or vegetation. The names of suborders have two syllables. The last syllable indicates the order. An example is *Aquent Aqu,* meaning water or wet, and *ent,* from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated; those that have pans that interfere with growth of roots, movement of water, or both; and thick, dark-colored surface horizons. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), dark-red and dark-brown colors associated with basic rocks, and the like. The names of great groups have three or four syllables and are made by adding a prefix to the name of the suborder. An example is Haplaquents (*Hapl,* meaning simple horizons, *aqu* for wetness or water, and *ent,* from Entisols).

SUBGROUP. Each great group is divided into subgroups, one representing the central (typic) segment of the group, and others called intergrades that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroup may also be made in those instances where soil properties intergrade outside the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Typic Haplaquolls (a typical Haplaquoll).

FAMILY. Soil families are established within a subgroup primarily on the basis of properties important to the growth of plants or on the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for texture, mineralogy, and so on, that are used to differentiate families (see table 13). An example is the coarse-loamy, mixed, mesic family of Typic Haplaquolls.

SERIES. The series consists of a group of soils that have soil horizons similar in differentiating characteristics and arrangement in the soil profile, except for the texture of the surface layer, and that formed in a particular type of parent material. Among the differentiating characteristics are color, structure, texture, reaction, consistence, content of carbonates and other salts, content of humus, and mineralogical composition.

Additional Facts About Columbia County

Settlers in the county first chose the timbered areas, which were similar to their former homes in forested lands. Later the prairies were cultivated. These former prairie soils are now some of the most fertile soils in the State. Wheat, oats, barley, rye, and flax constituted a large part of the farm products for a number of years. After the chinch bug infestation eliminated wheat as a major crop, farming became more diversified. Corn and oats became important grain crops, and stock raising and feeding and dairying contributed to the economy. Potatoes was an important early crop, tobacco was grown on some of the dark prairie soils, and sweet corn, peas, and cabbage were important cash crops.

Until 1950, dairying was the most important type of farming in Columbia County, as in most counties of southern Wisconsin. Since 1950, the number of cash grain and vegetable farms have increased, and all other types of farms have decreased. At the time of this survey, the principal crops were alfalfa, corn, sweet corn, peas, small grains, mint, cabbage, onions, truck crops, and small fruits. Livestock was chiefly beef, hogs, and sheep. Poultry and dairy products were also important to the economy of the county.

The present trend is toward larger acreages of all crops but small grain. Oats, barley, rye, and wheat are grown for seed and as winter cover crops. The trend in livestock production is towards larger numbers of beef cattle and hogs. The trend in dairying is toward fewer dairymen and larger herds. Therefore, the number of cows is expected to remain fairly stable. The numbers of sheep and poultry and egg production are also expected to remain constant.

Climate [7]

Columbia County has a continental climate, typical of the center of a continent in the middle latitudes.

[7] Prepared by HANS E. ROSENDAL, Wisconsin State climatologist, U.S. Department of Commerce, NOAA Weather Service.

Winters are long, cold, and snowy. Summers are warm and occasionally humid. Spring and fall are at times short and mixtures of both summer and winter. Spring often lingers into June, and the change from summer to fall is commonly abrupt. The seasons vary widely from year to year. All seasons are marked by storms that accompany changes from one air mass to another, particularly from late in fall through midspring when changes occur every 2 to 3 days.

Data in tables 14 and 15 are fairly representative of the climate of the county. The weather station from which most of these data were obtained is located in the city of Portage, not far from the Wisconsin River. At the higher elevations the daily and annual temperature ranges tend to decrease. At the lower elevations and on the large expanses of marshland, they tend to increase.

The number of days in a year on which the temperature is 90° F or higher has averaged 17, but has ranged from 39 in 1936 to 0 in 1951. The number of days in a year on which the temperature is 0° or less has averaged 19, but has ranged from 46 in 1963 to 3 in 1931. Heat growth units during the growing season above a 50° threshold have averaged 2,500.

Approximately 55 percent of the annual total of precipitation falls during the 5-month period May through September. Soil moisture is generally adequate for the first part of the growing season. After June, crops depend on rain that falls mainly during thunderstorms and tends to be erratic and variable. The likelihood of 1 inch or more of rain in a 7-day period is greater in the first, second, and fourth weeks of June and less during the last part of August than at any other time during the summer; the respective chances are 4 in 10 years and 2 in 10 years. The likelihood of no rain, a trace or less, in a 7-day period is greater the last part of August than at any other time during the summer; the chance is more than 3 in 10 years. Precipitation intensities of 1.3 inches in 1 hour, 2.1 inches in 6 hours, and 2.9 inches in 24 hours can be expected about once in 2 years.

Annual snowfall averages 41 inches, but has ranged from 19 inches in 1934 to 91 inches in 1959. The average date of the first 1-inch or greater snowfall is November 30. The chance of at least 1 inch of snow by November 2 is 1 in 10 years, and by December 28, 9 in 10 years. The possibility of snow cover increases until the middle of February and then decreases rapidly.

Thunderstorms have occurred on 20 to 55 days per year; the average is 41 days. Hail has fallen on an average of 2 days per year. The greatest number of hailstorms occurs in May, but hail stones are commonly small and do little damage. The most probable time for severe hailstorms is between 2 p.m. and 7 p.m. near the middle of July. Since 1916, six tornadoes have been confirmed in the county.

Records on wind and sunshine are not available for Portage, but the following data from Madison approximate conditions in Columbia County.

Prevailing winds are westerly in winter and southerly in summer. March, April, and November are the

TABLE 14.—*Temperature and precipitation data*

[Data from Portage, Wisconsin, elevation 785 feet]

Month	Temperature					Precipitation			
	Average daily maximum	Average daily minimum	Average maximum	Average minimum	Average precipitation	One year in 10 will have—		Number of days with snow cover of 1 inch or more	Average depth of snow on days with snow cover
						Less than—	More than—		
	°F	°F	°F	°F	*Inches*	*Inches*	*Inches*		*Inches*
January	29	11	43	−18	1.4	0.5	2.2	22	6.1
February	32	14	46	−12	1.2	.4	2.1	18	7.1
March	42	23	64	− 2	1.9	.9	3.0	10	5.3
April	58	37	77	21	2.9	1.4	4.2	2	2.1
May	71	48	85	28	3.2	1.6	5.1	(1)	------
June	80	59	90	38	4.0	2.0	6.5	------	------
July	85	63	92	45	3.4	1.7	6.0	------	------
August	83	61	91	42	3.3	1.5	5.6	------	------
September	74	53	87	31	3.6	.8	6.2	------	------
October	63	42	80	22	2.0	.4	4.7	(1)	------
November	45	29	63	7	2.2	.7	3.5	2	2.0
December	32	17	52	−10	1.4	.6	2.4	15	3.9
Year	58	38	[2] 94	[3] −19	30.5	21.6	39.5	69	5.5

[1] Less than 0.5 day. [2] Average annual highest temperature. [3] Average annual lowest temperature.

TABLE 15.—*Probabilities of last freezing temperatures in spring and first in fall*

[Data from Portage, Wisconsin, elevation 785 feet]

Probability	Dates for given probability and temperature				
	16° F or lower	20° F or lower	24° F or lower	28° F or lower	32° F or lower
Spring:					
1 year in 10 later than	April 6	April 15	April 21	May 2	May 14
2 years in 10 later than	March 31	April 10	April 16	April 27	May 9
5 years in 10 later than	March 20	March 30	April 5	April 17	April 29
Fall:					
1 year in 10 earlier than	November 3	October 27	October 18	October 6	September 25
2 years in 10 earlier than	November 9	November 1	October 24	October 12	September 30
5 years in 10 earlier than	November 19	November 12	November 4	October 23	October 11

windiest months, when the average windspeed is 12 miles per hour. July and August are the least windy; the windspeed averages 9 miles hour. Windspeed has averaged less than 4 miles per hour about 10 percent of the time, from 4 to 12 miles per hour about 50 percent, 13 to 31 miles per hour about 40 percent, and more than 31 miles per hour less than 1 percent. The strongest winds are generally from the west or southwest.

The average possible sunshine is about 40 percent for November and December, 60 percent and greater from May through October, and between 50 and 60 percent the rest of the year.

The average date of the last 32° freeze in spring is April 29, and the average date for the first in fall is October 11. The growing season, defined as the number of days between the last 32° freeze in spring and the first in fall, has averaged 165 days. Table 15 shows the likelihood of the occurrence of critical temperatures.

It must be noted that the freeze data are calculated for Portage and that minimum temperatures vary considerably across Columbia County on calm, clear nights, depending on the topography, the soil types of the area, and the proximity to open water.

Surface Water and Drainage

Approximately 4.5 percent, or 23,219 acres, of the county is covered by water. The 22 named lakes total 10,396 acres; the 34 unnamed lakes, 866 acres; the Wisconsin, Baraboo, Crawfish, and Fox Rivers, 11,560 acres; the named streams, 369 acres; and the unnamed tributary waters, 27.6 acres. The county is provided with 742 miles of river frontage and 124 miles of lake frontage.

Drainage is in three directions. The eastern part of the county is drained by the Crawfish River and Beaver Creek, both of which eventually empty into the Rock River and reach the Mississippi River in Illinois. The Wisconsin River drains the largest part of the county, the western, southwestern, northwestern, and central parts. The Fox River drains the north-central part, carrying the water to Lake Michigan and then out to the Atlantic Ocean by way of the St. Lawrence River. The Fox and Wisconsin Rivers, at the present site of Portage, flow within 2 miles of each other. This spot in the early days of the history of Wisconsin was an important portage point. Travelers came to this point from Lake Michigan via the Fox River, carried their canoes across the portage, paddled down the Wisconsin River to the Mississippi River, and then travelled on to the rest of the Midwest. Today, the two rivers are connected at this portage by a canal and locks. The locks are necessary because the Wisconsin River is about 5 feet higher than the Fox River.

About 31 percent, or 153,800 acres of Columbia County, is wet. The soils are saturated with water at a depth of less than 3 feet for significant periods during wet seasons. The map, "Distribution of Wet Soils," shows their location throughout the county.

These wet soils are designated as somewhat poorly drained, poorly drained, or very poorly drained by the Soil Conservation Service. The county has about 35,351 acres of somewhat poorly drained soils; 72,570 acres of poorly drained or very poorly drained mineral soils; 43,100 acres of very poorly drained organic soils; and 2,750 acres of Marsh.

These wet soils make up nearly all of the wetland in the county and provide excellent wildlife habitat. Many are well suited to crops, but artificial drainage is generally needed.

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Glossary

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed 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 capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Inches	
0 to 3	Very low
3 to 6	Low
6 to 9	Medium
9 to 12	High
12+	Very high

Blowout. An excavation produced by wind action in loose soil, usually sand.

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

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.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.
Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.
Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.
Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.
Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard and brittle; little affected by moistening.

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, 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 different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.
Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.
Well-drained soils are nearly free from mottling and are commonly of intermediate texture.
Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and mottling in the lower B and the C horizons.
Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.
Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.
Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Drift (geology). Material of any sort deposited by geologic processes in one place after having been removed from another; includes drift materials deposited by glaciers and by streams and lakes associated with them.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Esker (geology). A narrow, winding ridge or mound of stratified gravelly and sandy drift that was deposited by a subglacial stream.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors

such as light, moisture, temperature, and the physical condition of the soil are favorable.

Flood plain. Nearly level landfi consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Glacial outwash (geology). Cross-bedded gravel, sand, and silt deposited by meltwater as it flowed from glacial ice.

Glacial till (geology). Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Ground water (geology). Water that fills all the unblocked pores of underlying material below the water table, which is the upper limit of saturation.

Hemic material. Partially decomposed organic material having a bulk density of 6¼ to 12½ pounds per cubic foot. The fiber content (unrubbed) is between one-third and two-thirds of the organic volume and more than one-tenth after rubbing. When saturated, the maximum water content ranges from 450 to 850 percent on an ovendry basis. Peat, in this soil survey report, refers to hemic material.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Roman numerals are prefixed to the master horizon (O, A, B, C, R) to indicate lithologic discontinuities either within or below the solum. The first, or uppermost, material is not numbered, for the Roman numeral I is understood; the second, or contrasting, material is numbered II; and others are numbered III, IV, and so on, consecutively downward. Thus for example, a sequence from the surface downward might be A2, B1, IIB2, IIB3, IIC, IIIR.

Following are the symbols used in this survey with those letters that designate the master horizons:

a—sapric material.
e—hemic material.
g—strong gleying.
p—plow layer.
t—illuvial clay.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Types are these: Terminal, lateral, medial, ground.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of 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 these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Muck. An organic soil consisting of fairly well decomposed organic material that is relatively high in mineral content, finely divided, and dark in color.

Peat. Unconsolidated soil material, largely undecomposed organic matter, that has accumulated where there has been excess moisture.

Ped. An individual natural soil aggregate, such as a crumb, a a prism, or a block, in contrast to a clod.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Recessional moraine (geology). Hummocky ridges of drift that accumulated in front of glacial ice; caused by periodic retreats of the ice.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Sapric material. Highly decomposed organic material having a bulk density of more than 12½ pounds per cubic foot. The fiber content (unrubbed) is less than one-third the organic volume and one-tenth or less after rubbing. When saturated, the maximum water content averages less than 450 percent on an ovendry basis, (muck, in this soil survey report, refers to sapric material).

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that 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.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. 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 grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsidence. Depression or lowering of the surface of a soil as a result of oxidation, drying, or compaction.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 5 to 8 inches.

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 usefulness or 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 it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace, outwash. High bench remnants in valleys of material deposited by meltwater from glaciers.

Terrace, stream. An area that is fairly level and formerly was the flood plain of a stream but is now above the present flood plain.

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."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Variant, soil. A soil having properties sufficiently different from those of other known soils to suggest establishing a new soil series, but a soil of such limited known area that creation of a new series is not believed to be justified.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. Other information is given in tables as follows:

Acreage and extent, table 1, page 11.
Estimated yields, table 2, page 88.
Woodland, table 3, page 92.
Recreation, table 8, page 110.
Engineering, tables 9, 10, and 11, pages 114 through 141.

Map symbol	Mapping unit	Page	Capability unit		Woodland group	Landscape group	Wildlife group	Recreation group
			Symbol	Page				
Ad	Adrian muck	12	IVw-7	86	---	4	6	7
Ae	Alluvial land, sandy	13	IVw-5	85	3s1	3	7	6
Af	Alluvial land, sandy, wet	13	IVw-5	85	4w4	3	5b	6
Ag	Alluvial land, loamy	13	IIw-2	83	3o1	---	7	6
Ah	Alluvial land, loamy, wet	13	Vw-14	86	4w5	3	5b	6
AtA	Atterberry silt loam, 0 to 2 percent slopes	15	IIw-2	83	2w5	3	5a	4
AtB	Atterberry silt loam, 2 to 6 percent slopes	15	IIw-2	83	2w5	3	5a	4
BaB2	Baraboo silt loam, 2 to 6 percent slopes, eroded	16	IIe-2	82	2o1	1	1	1
BaC2	Baraboo silt loam, 6 to 12 percent slopes, eroded	16	IIIe-2	83	2o1	1	1	1
BaD	Baraboo silt loam, 12 to 20 percent slopes	16	IVe-2	85	2r2	1	1	1
BaE	Baraboo silt loam, 20 to 30 percent slopes	16	VIe-2	86	2r2	1	1	1
BbA	Barry loam, 0 to 3 percent slopes	17	IIw-1	83	4w5	3	5b	5
BnC	Boone loamy fine sand, 6 to 12 percent slopes	18	VIs-3	86	4s1	2	3	3
BnE	Boone loamy fine sand, 12 to 45 percent slopes	18	VIIs-9	87	4s2	2	3	3
Bo	Boots muck	18	IIIw-9	84	---	4	6	7
BpA	Boyer loamy sand, 0 to 2 percent slopes	19	IIIs-4	84	3o1	2	3	3
BpB	Boyer loamy sand, 2 to 6 percent slopes	19	IIIs-4	84	3o1	2	3	3
BpC2	Boyer loamy sand, 6 to 12 percent slopes, eroded	19	IIIe-7	84	3o1	2	3	3
BpD2	Boyer loamy sand, 12 to 30 percent slopes, eroded	20	IVe-7	85	3r2	2	3	3
BrA	Boyer fine sandy loam, 0 to 2 percent slopes	20	IIIs-4	84	3o1	2	1	2
BrB	Boyer fine sandy loam, 2 to 6 percent slopes	20	IIIs-4	84	3o1	2	1	2
BsB	Briggsville loam, 2 to 8 percent slopes	21	IIe-6	83	2c1	1	2	2
BtB2	Briggsville silt loam, silty subsoil variant, 1 to 6 percent slopes, eroded	21	IIe-1	82	2c1	1	2	1
CaB	Channahon silt loam, 2 to 6 percent slopes	22	IIIe-3	83	5d1	2	3	1
CaC2	Channahon silt loam, 6 to 12 percent slopes, eroded	22	IVe-3	85	5d1	2	3	1
CaE2	Channahon silt loam, 12 to 30 percent slopes, eroded	23	VIIe-3	87	5d2	2	3	1
ChB	Chelsea loamy fine sand, 1 to 6 percent slopes	23	IVs-3	86	3s1	2	3	3
ChC	Chelsea loamy fine sand, 6 to 12 percent slopes	24	VIs-3	86	3s1	2	3	3
CoA	Colwood fine sandy loam, 0 to 3 percent slopes	25	IIw-1	83	1w5	3	5b	5
DoB2	Dodge silt loam, 2 to 6 percent slopes, eroded	26	IIe-1	82	2o1	1	1	1
DoC2	Dodge silt loam, 6 to 12 percent slopes, eroded	26	IIIe-1	83	2o1	1	1	1

Map symbol	Mapping unit	Page	Capability unit Symbol	Page	Woodland group	Landscape group	Wildlife group	Recreation group
DoD2	Dodge silt loam, 12 to 20 percent slopes, eroded	26	IVe-1	85	2r2	1	1	1
DrB	Dresden loam, 1 to 6 percent slopes	27	IIe-2	82	2o1	1	1	2
DrC2	Dresden loam, 6 to 12 percent slopes, eroded	27	IIIe-2	83	2o1	1	1	2
DrD2	Dresden loam, 12 to 20 percent slopes, eroded	27	IVe-2	85	2r2	1	1	2
FrB	Friesland fine sandy loam, 1 to 6 percent slopes	28	IIe-1	82	---	1	4	2
GaA	Gilford fine sandy loam, stratified substratum, 0 to 3 percent slopes	29	IVw-3	85	4w4	3	5b	5
Gb	Granby loamy sand	29	IVw-5	85	3w4	3	5b	5
GeB	Grellton fine sandy loam, 1 to 6 percent slopes	30	IIe-1	82	2o1	1	1	2
GeC2	Grellton fine sandy loam, 6 to 12 percent slopes, eroded	30	IIIe-1	83	2o1	1	1	2
GnA	Grellton fine sandy loam, mottled subsoil variant, 0 to 4 percent slopes	31	IIw-2	83	2o1	3	5a	4
GrB2	Griswold silt loam, 2 to 6 percent slopes, eroded	32	IIe-1	82	---	1	4	1
GrC2	Griswold silt loam, 6 to 12 percent slopes, eroded	32	IIIe-1	83	---	1	4	1
GrD2	Griswold silt loam, 12 to 20 percent slopes, eroded	32	IVe-1	85	---	1	4	1
Ho	Houghton muck	33	IIIw-9	84	---	4	6	7
JoA	Joy silt loam, 0 to 4 percent slopes	34	IIw-2	83	4o1	3	5a	4
KbA	Kibbie fine sandy loam, 0 to 4 percent slopes	35	IIw-2	83	1o1	3	5a	4
KnB	Knowles silt loam, 2 to 6 percent slopes	36	IIe-2	82	2o1	1	1	1
KnC2	Knowles silt loam, 6 to 12 percent slopes, eroded	36	IIIe-2	83	2o1	1	1	1
KnD2	Knowles silt loam, 12 to 20 percent slopes, eroded	36	IVe-2	85	2r2	1	1	1
LaB	Lapeer fine sandy loam, 2 to 6 percent slopes	37	IIe-1	82	3o1	1	1	2
LaC2	Lapeer fine sandy loam, 6 to 12 percent slopes, eroded	37	IIIe-1	83	3o1	1	1	2
LaD2	Lapeer fine sandy loam, 12 to 20 percent slopes, eroded	37	IVe-1	85	3r2	1	1	2
LaE2	Lapeer fine sandy loam, 20 to 30 percent slopes, eroded	38	VIe-1	86	3r2	1	1	2
LoB	Lorenzo loam, 2 to 6 percent slopes	39	IIIe-3	83	3d1	1	3	2
LoC2	Lorenzo loam, 6 to 12 percent slopes, eroded	39	IVe-3	85	3d1	1	3	2
LoD2	Lorenzo loam, 12 to 20 percent slopes, eroded	40	VIe-3	86	3d2	1	3	2
MaB	Marcellon loam, 1 to 6 percent slopes	40	IIw-2	83	2o1	3	5a	4
Mb	Marsh	41	VIIIw-15	87	---	---	6	8
Mc	Marshan loam	42	IIw-1	83	4w5	---	5b	5
MeB2	McHenry silt loam, 2 to 6 percent slopes, eroded	43	IIe-1	82	2o1	1	1	1
MeC2	McHenry silt loam, 6 to 12 percent slopes, eroded	43	IIIe-1	83	2o1	1	1	1
MeD2	McHenry silt loam, 12 to 20 percent slopes, eroded	43	IVe-1	85	2r2	1	1	1
MnB	Military fine sandy loam, 2 to 6 percent slopes	44	IIe-2	82	2o1	1	1	2
MnC2	Military fine sandy loam, 6 to 12 percent slopes, eroded	44	IIIe-2	83	2o1	1	1	2

Map symbol	Mapping unit	Page	Capability unit		Woodland group	Landscape group	Wildlife group	Recreation group
			Symbol	Page				
MnD2	Military fine sandy loam, 12 to 20 percent slopes, eroded	44	IVe-2	85	2r2	1	1	2
MoA	Morocco loamy sand, 0 to 3 percent slopes	45	IVw-5	85	3w4	---	5a	4
MrD2	Mt. Carroll silt loam, 12 to 20 percent slopes, eroded	46	IVe-1	85	2r2	1	1	1
MtA	Mt. Carroll silt loam, benches, 0 to 2 percent slopes	46	I	82	2o1	1	1	1
MtB	Mt. Carroll silt loam, benches, 2 to 6 percent slopes	46	IIe-1	82	2o1	1	1	1
MtC2	Mt. Carroll silt loam, benches, 6 to 12 percent slopes, eroded	46	IIIe-1	83	2o1	1	1	1
NoB	Northfield sandy loam, 2 to 6 percent slopes	47	IIIe-3	83	3d1	2	3	2
NoC	Northfield sandy loam, 6 to 12 percent slopes	47	IVe-3	85	3d1	2	3	2
NoE	Northfield sandy loam, 12 to 30 percent slopes	47	VIIe-3	87	3d2	2	3	2
OkB	Okee loamy fine sand, 2 to 6 percent slopes	48	IIIs-4	84	2s1	2	3	3
OkC	Okee loamy fine sand, 6 to 12 percent slopes	48	IIIe-7	84	2s1	2	3	3
OmA	Oshtemo loamy sand, 0 to 2 percent slopes	49	IIIs-4	84	3o1	2	3	3
OmB	Oshtemo loamy sand, 2 to 6 percent slopes	49	IIIs-4	84	3o1	2	3	3
OmC2	Oshtemo loamy sand, 6 to 12 percent slopes, eroded	49	IIIe-7	84	3o1	2	3	3
OmD2	Oshtemo loamy sand, 12 to 20 percent slopes, eroded	49	IVe-7	85	3r2	2	3	3
OsA	Ossian silt loam, 0 to 3 percent slopes	50	IIw-1	83	3w5	3	5b	5
Ot	Otter silt loam	51	IIw-1	83	1w5	3	5b	6
Pa	Palms muck	52	IIw-8	83	---	4	6	7
PeC2	Plainfield sand, 2 to 12 percent slopes, eroded	52	VIIs-9	87	3s1	2	3	8
PfA	Plainfield loamy fine sand, 0 to 2 percent slopes	53	IVs-3	86	3s1	2	3	3
PfB	Plainfield loamy fine sand, 2 to 6 percent slopes	53	IVs-3	86	3s1	2	3	3
PfC	Plainfield loamy fine sand, 6 to 12 percent slopes	54	VIs-3	86	3s1	2	3	3
PfD	Plainfield loamy fine sand, 12 to 25 percent slopes	54	VIIs-3	87	3s2	2	3	3
PkB	Plainfield loamy fine sand, loamy substratum, 2 to 6 percent slopes	54	IVs-3	86	3s1	2	3	3
PkC	Plainfield loamy fine sand, loamy substratum, 6 to 12 percent slopes	54	VIs-3	86	3s1	2	3	3
PkD	Plainfield loamy fine sand, loamy substratum, 12 to 25 percent slopes	54	VIIs-3	87	3s2	2	3	3
PnA	Plano silt loam, 0 to 2 percent slopes	55	I	82	---	1	4	1
PnB	Plano silt loam, 2 to 6 percent slopes	55	IIe-1	82	---	1	4	1
PnC2	Plano silt loam, 6 to 12 percent slopes, eroded	55	IIIe-1	83	---	1	4	1
PoA	Poygan silt loam, 0 to 3 percent slopes	56	IIw-1	83	3w5	3	5b	5
PuB	Puchyan loamy fine sand, 2 to 6 percent slopes	57	IIIe-4	84	3o1	1	3	3
PuC	Puchyan loamy fine sand, 6 to 12 percent slopes	57	IVe-4	85	3o1	1	3	3
RdB2	Ringwood silt loam, 1 to 6 percent slopes, eroded	58	IIe-1	82	---	1	4	1

Map symbol	Mapping unit	Page	Capability unit		Woodland group	Landscape group	Wildlife group	Recreation group
			Symbol	Page				
RdC2	Ringwood silt loam, 6 to 12 percent slopes, eroded	58	IIIe-1	83	---	1	4	1
ReB	Ripon silt loam, 2 to 6 percent slopes	59	IIe-2	82	---	1	4	1
ReC2	Ripon silt loam, 6 to 12 percent slopes, eroded	59	IIIe-2	83	---	1	4	1
Rk	Rock land	59	VIIIs-10	87	4d2	2	8	8
RoC	Rodman gravelly loam, 2 to 12 percent slopes	60	VIs-5	87	4f1	2	8	8
RoD	Rodman gravelly loam, 12 to 20 percent slopes	60	VIs-5	87	4f2	2	8	8
RoE	Rodman gravelly loam, 20 to 45 percent slopes	61	VIIs-5	87	4f2	2	8	8
RtB	Rotamer loam, 2 to 6 percent slopes	61	IIIe-4	84	---	1	4	2
RtC2	Rotamer loam, 6 to 12 percent slopes, eroded	61	IVe-4	85	---	1	4	2
RtD2	Rotamer loam, 12 to 20 percent slopes, eroded	62	VIe-4	86	---	1	4	2
RtE2	Rotamer loam, 20 to 30 percent slopes, eroded	62	VIIe-4	87	---	1	4	2
SaA	St. Charles silt loam, 0 to 2 percent slopes	63	I	82	1o1	1	1	1
SaB2	St. Charles silt loam, 2 to 6 percent slopes, eroded	63	IIe-1	82	1o1	1	1	1
SaC2	St. Charles silt loam, 6 to 12 percent slopes, eroded	63	IIIe-1	83	1o1	1	1	1
SaD2	St. Charles silt loam, 12 to 20 percent slopes, eroded	63	IVe-1	85	1r2	1	1	1
SaE	St. Charles silt loam, 20 to 30 percent slopes	63	VIe-1	86	1r2	1	1	1
SbA	Salter fine sandy loam, 0 to 2 percent slopes	65	IIIs-4	84	1o1	1	1	2
SbB	Salter fine sandy loam, 2 to 6 percent slopes	65	IIIs-4	84	1o1	1	1	2
SbC2	Salter fine sandy loam, 6 to 12 percent slopes, eroded	65	IIIe-7	84	1o1	1	1	2
SbD2	Salter fine sandy loam, 12 to 20 percent slopes, eroded	65	IVe-7	85	1r2	1	1	2
ScB	Salter fine sandy loam, dark surface variant, 1 to 6 percent slopes	66	IIIs-4	84	1o1	1	4	2
Sd	Sandy land	66	VIIIs-10	87	---	2	8	8
SeB2	Saybrook silt loam, 2 to 6 percent slopes, eroded	67	IIe-1	82	---	1	4	1
SeC2	Saybrook silt loam, 6 to 12 percent slopes, eroded	67	IIIe-1	83	---	1	4	1
SeD2	Saybrook silt loam, 12 to 20 percent slopes, eroded	67	IVe-1	85	---	1	4	1
SfA	Seaton silt loam, 0 to 2 percent slopes	68	I	82	1o1	1	1	1
SfB2	Seaton silt loam, 2 to 6 percent slopes, eroded	68	IIe-1	82	1o1	1	1	1
SfC2	Seaton silt loam, 6 to 12 percent slopes, eroded	68	IIIe-1	83	1o1	1	1	1
SfD2	Seaton silt loam, 12 to 20 percent slopes, eroded	68	IVe-1	85	1r2	1	1	1
SnA	Sisson fine sandy loam, 0 to 2 percent slopes	69	I	82	2o1	1	1	2
SnB	Sisson fine sandy loam, 2 to 6 percent slopes	69	IIe-1	82	2o1	1	1	2
SnC2	Sisson fine sandy loam, 6 to 12 percent slopes, eroded	69	IIIe-1	83	2o1	1	1	2

Map symbol	Mapping unit	Page	Capability unit		Woodland group	Landscape group	Wildlife group	Recreation group
			Symbol	Page				
SnD2	Sisson fine sandy loam, 12 to 20 percent slopes, eroded	70	IVe-1	85	2r2	1	1	2
SnE	Sisson fine sandy loam, 20 to 30 percent slopes	70	VIe-1	86	2r2	1	1	2
SpB	Sparta loamy fine sand, 1 to 6 percent slopes	70	IVs-3	86	3s1	2	3	3
TsA	Troxel silt loam, 0 to 3 percent slopes	71	I	82	2o1	1	4	1
TuB	Tustin loamy fine sand, 2 to 6 percent slopes	72	IIIe-4	84	3o1	2	3	3
TvA	Tustin loamy fine sand, mottled subsoil variant, 0 to 4 percent slopes	73	IIIw-6	84	3o1	2	5a	4
Wa	Wacousta mucky silt loam	73	IIw-1	83	3w5	3	5b	5
Wb	Wallkill silt loam	74	IIw-1	83	4w5	3	5b	6
WcA	Wasepi fine sandy loam, 0 to 3 percent slopes	75	IVw-5	85	3o1	3	5a	4
WnB	Winneshiek fine sandy loam, 2 to 6 percent slopes	76	IIe-2	82	2o1	1	1	2
WnC2	Winneshiek fine sandy loam, 6 to 12 percent slopes, eroded	76	IIIe-2	83	2o1	1	1	2
WoB	Wyocena loamy sand, 2 to 6 percent slopes	76	IIIe-4	84	3o1	2	3	3
WoC2	Wyocena loamy sand, 6 to 12 percent slopes, eroded	77	IVe-4	85	3o1	2	3	3
WoD2	Wyocena loamy sand, 12 to 20 percent slopes, eroded	77	VIe-4	86	3r2	2	3	3
WoE	Wyocena loamy sand, 20 to 45 percent slopes	77	VIIe-4	87	3r2	2	3	3
WxB	Wyocena sandy loam, 2 to 6 percent slopes	77	IIIe-4	84	3o1	2	1	2
WxC2	Wyocena sandy loam, 6 to 12 percent slopes, eroded	77	IVe-4	85	3o1	2	1	2
WxD2	Wyocena sandy loam, 12 to 20 percent slopes, eroded	78	VIe-4	86	3r2	2	1	2
WyB	Wyocena fine sandy loam, sandstone substratum, 2 to 6 percent slopes	78	IIIe-4	84	3o1	2	1	2
WyC2	Wyocena fine sandy loam, sandstone substratum, 6 to 12 percent slopes, eroded	78	IVe-4	85	3o1	2	1	2
WyD2	Wyocena fine sandy loam, sandstone substratum, 12 to 20 percent slopes, eroded	78	VIe-4	86	3r2	2	1	2
WyE	Wyocena fine sandy loam, sandstone substratum, 20 to 45 percent slopes	79	VIIe-4	87	3r2	2	1	2
YaA	Yahara fine sandy loam, 0 to 4 percent slopes	80	IIw-2	83	1o1	3	5a	4

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