Topographic features, particularly slope steepness, have a direct bearing on the potential for soil erosion and the sedimentation of surface waters. Slope steepness affects the velocity and, accordingly, the erosive potential of runoff. As a result, steep slopes place moderate to severe limitations on urban development and agricultural activities, especially in areas with highly erodible soil types such as the Kettle Moraine. Map 12 indicates that significant portions of Waukesha County have slopes exceeding 12 percent, with many such areas located along the Kettle Moraine in the southwestern quarter of the County. Over 57 square miles, or about 10 percent of the total land area in the County, have slopes of 20 percent or greater; while 64 square miles, or about 11 percent of the total land area of the County, have slopes from 12 to 20 percent. Poorly planned hillside development in these areas can lead to high costs for public infrastructure development and maintenance and to severe construction and postconstruction erosion problems. Steeply sloped agricultural lands may make the operation of agricultural equipment difficult or even hazardous. Development or cultivation of steeply sloped lands is also likely to impact surface water quality negatively through related erosion and sedimentation.

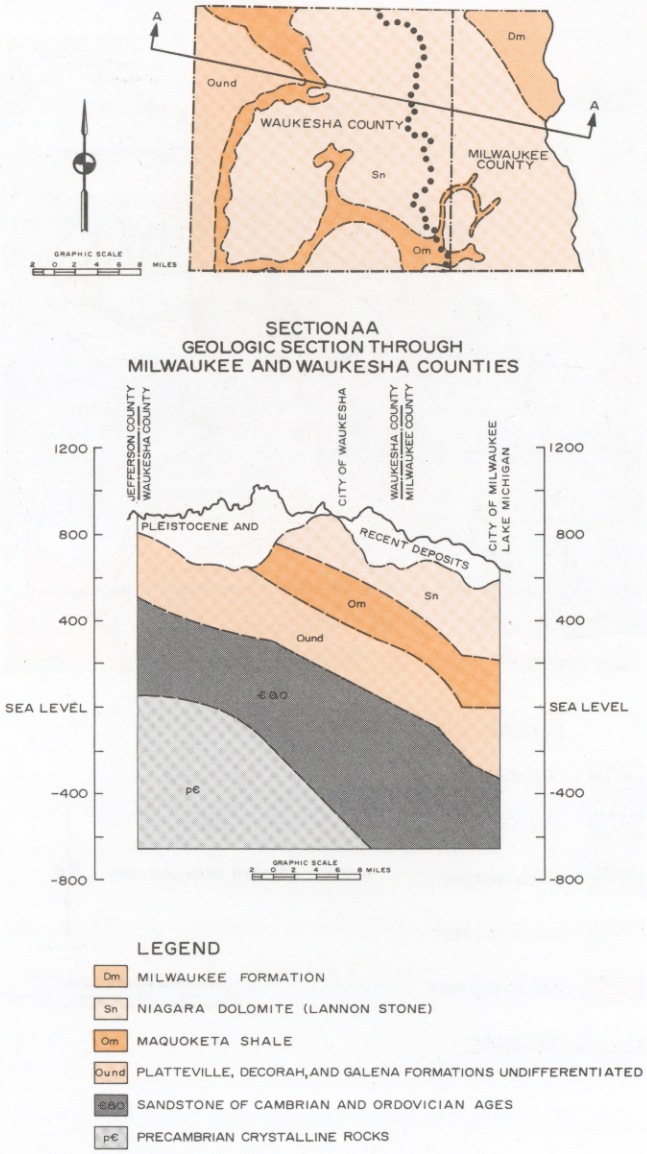
SOILS

Soil properties exert a strong influence on the manner in which land is used, since they affect the costs and feasibility of building site development and provision of public facilities. In the case of productive agricultural lands and potential mineral extraction areas, soils are a valuable and irreplaceable resource. A need, therefore, exists in any planning program to examine not only how land and soils are currently used, but how they can best be used and managed. Soil suitability interpretations for specific types of urban and rural land uses are therefore important aids to physical development planning and for determining the best use of soils within an area.

In 1963, to assess the significance of the diverse soils found in Southeastern Wisconsin, the Southeastern Wisconsin Regional Planning Commission negotiated a cooperative agreement with the U. S. Department of Agriculture, Soil Conservation Service (SCS), under which detailed operational soil surveys were completed for the entire Region. The results of the soil surveys have been published in

Map 10

MAP AND CROSS-SECTION OF BEDROCK GEOLOGY IN WAUKESHA COUNTY

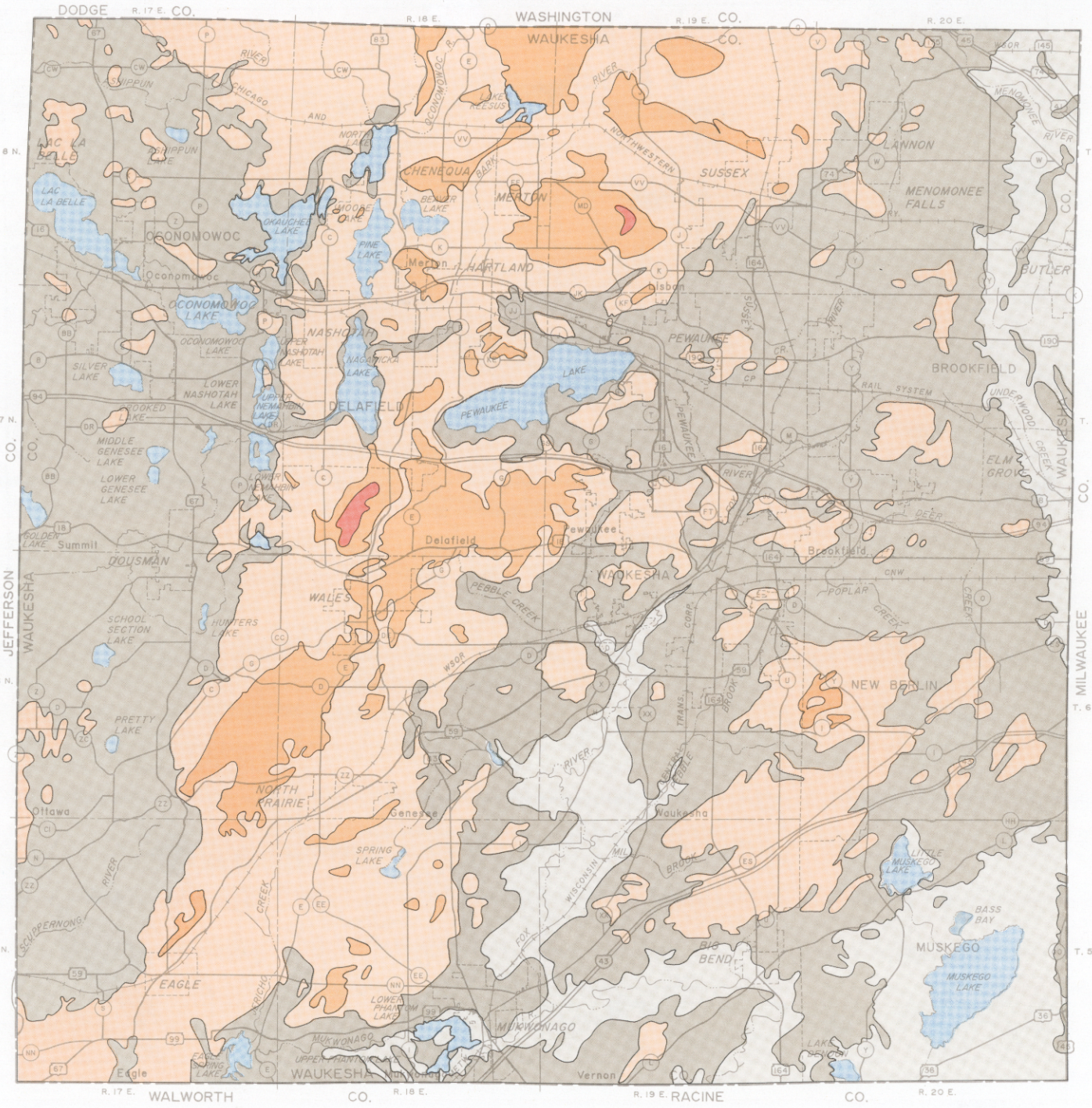


Source: SEWRPC.

SEWRPC Planning Report No. 8, Soils of Southeastern Wisconsin. These soil surveys have resulted in the mapping of the soils within the Region in great detail. At the same time, the surveys have provided definitive data on the physical, chemical, and biological properties of the soils and, more importantly, have provided interpretations of the soil properties for planning, engineering, agricultural, and resource conservation purposes.

Map 11

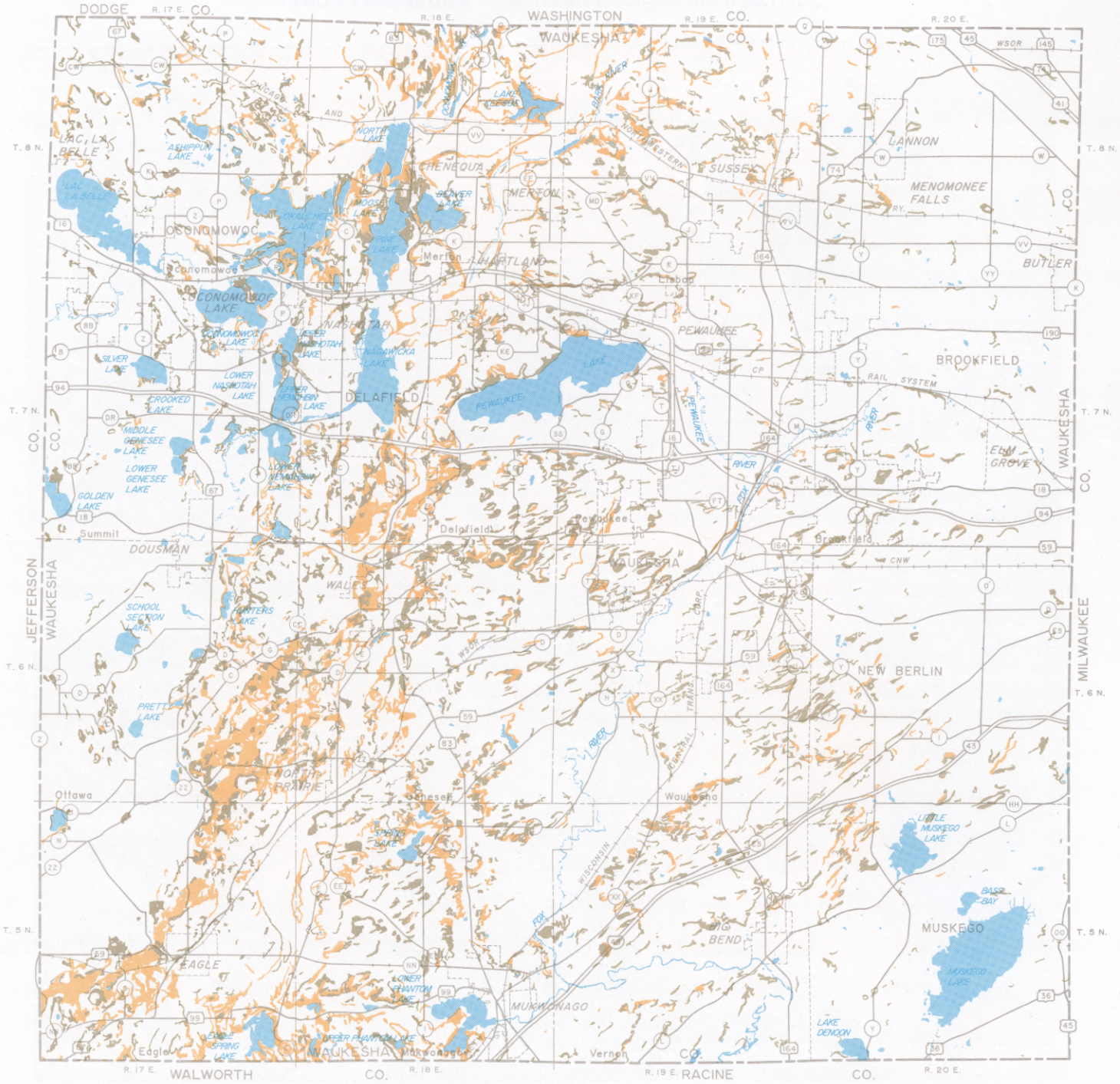
TOPOGRAPHIC CHARACTERISTICS OF WAUKESHA COUNTY



Source: SEWRPC.

Map 12

SLOPE ANALYSIS FOR WAUKESHA COUNTY



LEGEND

- SOILS HAVING SLOPES RANGING FROM 0 TO 12 PERCENT
- SOILS HAVING SLOPES RANGING FROM 12 TO 20 PERCENT
- SOILS HAVING SLOPES OF 20 PERCENT OR MORE
- SURFACE WATER

GRAPHIC SCALE

0 — 2 MILES

0 — 4000 — 8000 — 12000 — 16000 FEET

Source: U. S. Soil Conservation Service and SEWRPC.

Major Soil Association Groups

The soils in Waukesha County range from very poorly drained organic soils to excessively drained mineral soils. General grouping of these soils into soil associations is useful for comparing the suitability of relatively large areas of the County for various land uses. A soil association is defined as a landscape with a distinctive proportional pattern of soils, typically comprised of one or more major soil types and at least one minor soil type, as identified by the U. S. Department of Agriculture, Soil Conservation Service, and named after the major soils. Nine soil associations are found in the County, A description of the soil associations in Waukesha County, along with their spatial distribution within the County, is presented on Map 13.

Soil Suitability Interpretations

The soil surveys provide important information regarding the suitability of the land for various urban and rural land uses. Interpreting soil surveys in this manner involves evaluating those characteristics of a soil which influence a particular use and predicting the kinds and degrees of limitations those soil properties and qualities, taken together, are likely to impose on the land use in question. Of particular importance in the planning program for Waukesha County are suitability interpretations for residential development with public sanitary sewer service, residential development with onsite sewage disposal systems, suitability for agriculture, and suitability for extraction of minerals. It should be noted that, although soil suitability maps are presented at a relatively small scale in this report, the primary source maps maintained by the Regional Planning Commission are at a scale of one inch equals 4,000 feet, suitable for use in community-level planning.

Suitability for Residential Development Served by Public Sanitary Sewers: The detailed soil surveys indicate that 216 square miles, or about 37 percent of the total land area of the County, is covered by soils that exhibit severe limitations for residential development served by public sanitary sewer service, or, stated differently, are unsuitable for residential development of any kind. As shown on Map 14, these soils are found in large areas throughout the County and are typically located in such wet, low-lying areas as the Vernon Marsh and other wetlands associated with watercourses in the County.

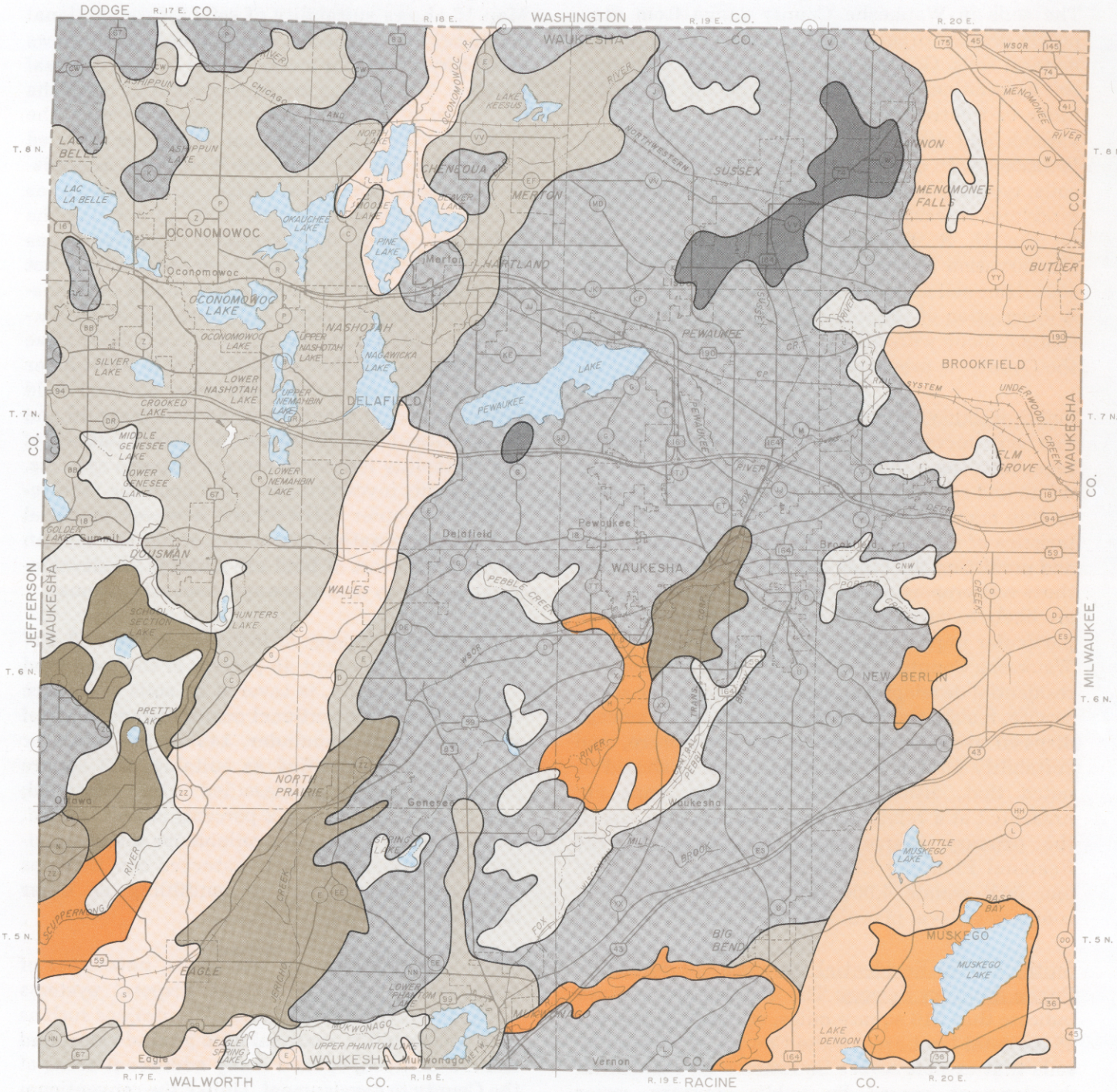
Suitability for Onsite Sewage Disposal Systems: The suitability of soils in Waukesha County for onsite sewage disposal systems is indicated in Table 33. Map 15 shows suitability of soils for conventional onsite sewage disposal systems, and Map 16 shows suitability of soils for mound onsite sewage disposal systems. The ratings are expressed in terms of the likelihood of meeting the criteria governing the siting of onsite sewage disposal systems as specified in Chapter ILHR 83 of the Wisconsin Administrative Code. On these maps, areas shown as "suitable" have a high probability of meeting the code requirements for the system concerned; areas shown as "unsuitable" have a high probability of not meeting the requirements. Areas shown as "undetermined" include soils with a range of characteristics which spans the applicable administrative code criteria, so that classification is difficult or impossible to assign without more detailed field investigations. It should be noted that Maps 15 and 16 are intended to illustrate the overall pattern of soil suitability for onsite sewage disposal systems. Detailed site investigations based upon the requirements of Chapter ILHR 83 are, however, essential to the determination of whether or not the soils on any specific tract of land are suitable for development served by onsite sewage disposal systems.

Conventional Systems: As indicated in Table 33, 247 square miles, or about 45 percent of the total land area of the County, is covered by soils which are unsuitable for conventional onsite sewage disposal systems. Of the remainder, 143 square miles, or 26 percent, is classified as suitable; 152 square miles, or 27 percent, is classified as undetermined; and 13 square miles, or 2 percent, is unclassified. Soil survey data are not available for the unclassified areas because of such disturbed conditions as extensive modification by landfilling or other means.

Mound Systems: In the late 1970s, new types of onsite soil absorption sewage disposal systems designed to overcome certain soil limitations such as slow permeability, seasonal high groundwater, and shallow bedrock, opened many additional areas of the County to development. Unlike the conventional gravity- flow septic tank system, the new systems utilize mechanical facilities to pump septic tank effluent through small-diameter perforated distribution pipes placed in clean, medium sand fill on top of the natural soil. When in place, this fill takes on the appearance of a mound; hence, the new systems are commonly called "mound systems." As indicated in Table 33, approximately 274 square miles, or about 49 percent of the total land area of the County, is covered by soils considered suitable for

Map 13

GENERAL SOIL ASSOCIATIONS IN WAUKESHA COUNTY



LEGEND

- HOUGHTON-PALMS-ADRIAN ASSOCIATION: VERY POORLY DRAINED ORGANIC SOILS IN DEPRESSIONS ON OLD LAKEBEDS AND ON FLOODPLAINS
- FOX-CASCO ASSOCIATION: WELL-DRAINED SOILS THAT HAVE A SUBSOIL OF CLAY LOAM; MODERATELY DEEP TO SHALLOW OVER SAND AND GRAVEL, ON OUTWASH PLAINS AND STREAM TERRACES
- WARSAW-LORENZO ASSOCIATION: WELL-DRAINED SOILS THAT HAVE A SUBSOIL OF CLAY LOAM; MODERATELY DEEP OVER SAND AND GRAVEL, ON OUTWASH PLAINS AND RIVER TERRACES
- BOYER-OSHTEMO ASSOCIATION: WELL-DRAINED SOILS THAT HAVE A SUBSURFACE OF SANDY LOAM AND SANDY CLAY LOAM; UNDERLAIN BY SANDY MATERIAL, ON OUTWASH PLAINS
- RODMAN-CASCO ASSOCIATION: EXCESSIVELY DRAINED TO WELL-DRAINED SOILS THAT HAVE A SUBSOIL OF GRAVELLY SANDY LOAM AND CLAY LOAM; SHALLOW OVER GRAVEL AND SAND, ON THE KETTLE MORAINE
- OZAUKEE-MORLEY-MEQUON ASSOCIATION: WELL-DRAINED TO SOMEWHAT POORLY DRAINED SOILS THAT HAVE A SUBSOIL OF SILTY CLAY LOAM AND SILTY CLAY; FORMED IN THIN LOESS AND SILTY CLAY LOAM GLACIAL TILL, ON MORAINES
- MONTGOMERY-MARTINTON-HEBRON-SAYLESVILLE ASSOCIATION: POORLY DRAINED TO WELL DRAINED SOILS THAT HAVE A SUBSOIL OF CLAY TO CLAY LOAM; FORMED IN SILTY CLAY OR SILTY CLAY LOAM SEDIMENTS, IN OLD LAKEBEDS
- HOCHHEIM-THERESA ASSOCIATION: WELL-DRAINED SOILS THAT HAVE A SUBSOIL OF CLAY LOAM AND SILTY CLAY LOAM; FORMED IN THIN LOESS AND LOAM GLACIAL TILL, ON GROUND MORAINES
- PELLA, MODERATELY SHALLOW VARIANT-KNOWLES ASSOCIATION: POORLY DRAINED AND WELL-DRAINED SOILS THAT HAVE A SUBSOIL OF SILTY CLAY LOAM OR CLAY LOAM; MODERATELY SHALLOW OVER DOLOMITE BEDROCK

Source: U. S. Soil Conservation Service and SEWRPC.

Map 14

SUITABILITY OF SOILS FOR RESIDENTIAL DEVELOPMENT WITH PUBLIC SANITARY SEWER SERVICE IN WAUKESHA COUNTY

LEGEND

- AREAS COVERED BY SOILS HAVING SEVERE LIMITATIONS FOR RESIDENTIAL DEVELOPMENT WITH PUBLIC SANITARY SEWER SERVICE
- AREAS COVERED BY SOILS HAVING SLIGHT OR MODERATE LIMITATIONS FOR RESIDENTIAL DEVELOPMENT WITH PUBLIC SANITARY SEWER SERVICE
- UNCLASSIFIED SOILS
- SURFACE WATER

GRAPHIC SCALE

0 1 2 MILES

0 4000 8000 12000 16000 FEET

Source: U. S. Soil Conservation Service and SEWRPC.

Table 33

SUITABILITY OF SOILS FOR ONSITE SEWAGE DISPOSAL SYSTEMS IN WAUKESHA COUNTY

Classification	Conventional Systems		Mound Systems	
	Square Miles	Percent of Land Area	Square Miles	Percent of Land Area
Suitable	143.0	25.8	273.8	49.3
Unsuitable	247.4	44.6	188.0	33.9
Undetermined	151.6	27.3	80.2	14.5
Unclassified	13.0	2.3	13.0	2.3
Total Land[a]	555.0	100.0	555.0	100.0

[a]*Does not include 25.6 square miles of surface water in the County.*

Source: SEWRPC.

about 49 percent of the total land area of the County, is covered by soils considered suitable for mound onsite sewage disposal systems. Of the remainder, 188 square miles, or 34 percent, is covered by soils classified as unsuitable; 80 square miles, or 15 percent, is covered by soils classified as undetermined; and 13 square miles, or 2 percent, is denoted as unclassified.

Suitability for Agriculture: In order to lend uniformity to the identification of productive farmlands throughout the nation, the U. S. Department of Agriculture, Soil Conservation Service, established a soil classification system under which soils are categorized relative to their agricultural productivity. The two most highly productive soils are categorized as either National prime farmland or as farmland of statewide significance. National prime farmland is defined as land that is well suited for the production of food, feed, forage, fiber, and oilseed crops, with the soil quality, growing season, and moisture supply needed to produce economically sustained high yields of crops when properly treated and managed. Farmland of statewide importance includes land in addition to national prime farmland which is of statewide importance for the production of food, feed, fiber, forage, and oilseed crops.

As indicated on Map 17, approximately half of the land in Waukesha County is covered by soils that are well suited for agricultural use, classified as either National prime farmland or farmland of statewide importance. Approximately 211 square miles, or 38 percent of the total land area of the County, is covered by soils designated as national prime farmland; 61 square miles, or 11 percent, is covered by soils designated as farmland of statewide importance.

Although careful consideration must be given to a number of factors other than soils in the identification of prime farmlands, soil suitability is one of the most important of these factors. Other factors which shall be considered in the identification of prime farmlands are addressed in Chapter IV of this report.

Suitability for Extraction of Minerals: Waukesha County has an abundant supply of sand, gravel, and stone. The soils around and in the Kettle Moraine are the most likely source areas for sand and gravel. In this area, the melting waters of the glacier were most active in sorting and depositing high-quality sand and gravel as kames, eskers, and outwash terraces. Ground moraine, common in other parts of the County, typically has not been sorted, as has the glacial outwash, and is generally not as well suited for commercial sand and gravel. Potential sand and gravel deposit areas, as shown on Map 18, comprise 210 square miles, or 38 percent of the total land area of the County. These areas are concentrated in the western half of the County along the Kettle Moraine and on outwash plains, although many other small deposits are also scattered throughout the remainder of the County.

The Waukesha County soils most commonly suitable for supplying sand and gravel are the Adrian, Boyer, Casco, Drummer, Fabius, Fox, Gilford, Granby, Kane, Lorenzo, Matherton, Mussey, Oshtemo, Rodman, St. Charles, Sebewa, Virgil, Warsaw, and Wasepi series, all underlaid by glacial outwash. The deposits are extremely variable; thus onsite investigations are usually necessary to determine the suitability of each site for a specific purpose.

Soils with depth to bedrock of two feet or less in Waukesha County are shown on Map 19, and indicate areas most suitable for quarrying stone. These soils cover approximately 8.3 square miles, or 1.5 percent of the total land area of the County. As indicated previously, the largest areas are concentrated near the Villages of Lannon and Sussex, with some smaller areas in other parts of the County. The soils most likely to overlie dolomite bedrock at shallow depths are the Knowles, Pella (shallow variant), and Ritchey series.

GROUNDWATER RESOURCES

Except for a 52-acre parcel of land located in U. S. Public Land Survey Township 8 North, Range 20 East, Section 25, in the City of Milwaukee, Wauke-