

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY, E. A. BIRGE, DIRECTOR; COLLEGE OF AGRICULTURE, UNIVERSITY OF WISCONSIN, H. L. RUSSELL, DEAN; A. R. WHITSON, IN CHARGE SOIL SURVEY.

SOIL SURVEY OF MILWAUKEE COUNTY,
WISCONSIN.

BY

W. J. GEIB, OF THE U. S. DEPARTMENT OF AGRICULTURE, IN CHARGE, AND T. J. DUNNEWALD, OF THE WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY.

THOMAS D. RICE, INSPECTOR, NORTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1916.]



WASHINGTON:
GOVERNMENT PRINTING OFFICE,
1918.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,

Washington, D. C., December 5, 1917.

SIR: Field operations of the Bureau of Soils for 1916 included a soil survey of Milwaukee County, Wisconsin, undertaken in cooperation with the Wisconsin Geological and Natural History Survey.

I have the honor to transmit herewith the manuscript and map covering this work and to recommend their publication as advance sheets of Field Operations of the Bureau of Soils for 1916, as authorized by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

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FIGURE.

FIG. 1. Sketch map showing location of the Milwaukee County area, Wisconsin.

MAP.

Soil map, Milwaukee County sheet, Wisconsin.

SOIL SURVEY OF MILWAUKEE COUNTY, WISCONSIN.

By W. J. GEIB, of the U. S. Department of Agriculture, In Charge, and T. J. DUNNEWALD, of the Wisconsin Geological and Natural History Survey.—
Area Inspected by THOMAS D. RICE.

DESCRIPTION OF THE AREA.

Milwaukee County is located in the southeastern part of Wisconsin. It is bounded on the north by Ozaukee County, on the east by Lake Michigan, on the south by Racine County, and on the west by Waukesha County. The city of Milwaukee is in the east-central part. The county varies from 8 to 12 miles in width east and west and is 24 miles long. It has a total area of 241 square miles, or 154,240 acres.

The topography of Milwaukee County, which is constructional, consists of three low, broad, flat-topped, but rather distinct ridges running north and south parallel to the lake shore and separated by two shallow, narrow, lowland belts. All the ridges curve with the indentation of the coast line at Milwaukee, but elsewhere do not trend with the details of the coast line. Half of the first ridge has been removed between Milwaukee and the southern line of the county by the landward sapping of the lake, so that the lake shore lies approximately along the crest of the ridge, the height of the lake cliff, therefore, varying with the height of the ridge. North of Milwaukee the lake seems to have cut away about half of the ridge also. The remaining part of this ridge has a maximum width of about 3 miles in the northern part of the city of Milwaukee and at the northern boundary of the county. Elsewhere the width is half that or less.

The width of the first lowland ranges from a quarter mile locally at several places to expansions of more than a mile, as in the area of Peat west of Ryan, another southwest of Cudahy, and one near

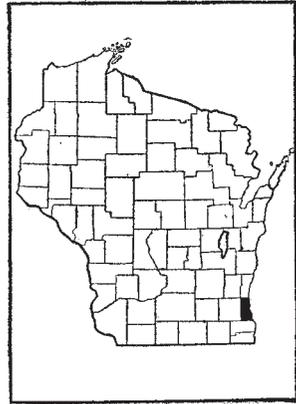


FIG. 1.—Sketch map showing location of the Milwaukee County area, Wisconsin.

North Milwaukee. It lies about 40 feet lower than the top of the first ridge.

The second ridge has a width of about 5 miles throughout its course in the county. Its maximum elevation is about 140 feet and its general elevation about 80 feet above the lowland east of it. Its surface is undulating to rolling, owing to the existence of a number of subordinate ridges with the same trend as that of the main ridge.

The second lowland belt has a width about the same as that of the first belt. It lies about 100 feet below the general level of the top of the second ridge.

The third ridge, only the eastern part of which lies within the county, is essentially like the second.

The drainage of the county consists of a number of small streams following the lowland belts and a few larger streams following the lowland belts in part and in part cutting their way across the ridges. In a few instances the small streams have cut valleys across low parts of the ridges. The Milwaukee River has cut a narrow valley across the western part of the first ridge west of Fox Point and across the eastern part in the northern part of the city of Milwaukee. The Menominee River has cut a narrow valley across the second ridge between Wauwatosa and the western part of the city of Milwaukee and a broader one across the eastern ridge within the city. The Root River has cut a narrow valley across the second ridge where it runs in an eastward course along the southern boundary of the county, and Oak Creek crosses the first ridge in South Milwaukee. In those parts of their courses not mentioned above these streams occupy the lowland belts in a misfit way just like the small streams. The lowland belts were made before the existing streams were formed and by other forces. The local drainage is mainly into small basins, lakes, and ponds, and occasionally into the existing streams described above. The natural provision for the surface drainage of the county is very incomplete.

Milwaukee County was created in 1836. It then included a large area to the north, west, and south of the present county, and was not reduced to its present size until 1846.

The first settlers in the county were mainly English and French. Later German settlers largely occupied the northern and western sections. Subsequently German settlement spread to the southern part of the county, which had been occupied mainly by Irish. While the present population is largely German (about 60 per cent), it comprises many other nationalities. Many of the gardeners, especially south of Milwaukee, are of Polish descent.

The total population of Milwaukee County is reported in the 1910 census as 433,187. The rural population is given as 39,556, or about

9 per cent of the total, averaging about 168 per square mile. The density of the rural population of Milwaukee County is greater than that of any other county in the State. The density of population is greatest along the lake.

Milwaukee, with a population of 373,857, according to the 1910 census, is the county seat. Whitefish Bay, North Milwaukee, and Granville, in the northwestern corner of the county, Wauwatosa and West Allis, to the west of the city, and Bayview, St. Francis, Cudahy, South Milwaukee, and Carrollville, to the south of the city, are important towns. Hales Corners and St. Martins are located in the southwestern part of the county.

All the towns are connected directly by steam or electric railway with Milwaukee. The Chicago, Milwaukee & St. Paul Railroad has a double-track line from the city southward, and the Waukesha, Watertown, Fond du Lac, and Green Bay branches running west and north. The Chicago & North Western has two double-track lines, one freight and one passenger, running south, and the Madison, La Crosse, Fond du Lac, and Manitowoc branches extending west and north from the city.

Of the electric interurban lines the Racine line of the Milwaukee Electric Railroad & Light Co. and the Chicago, Northshore & Milwaukee Electric Railway extend southward from the city, and the Troy and Muskego Lake lines of the former system westward to West Allis and south through Hales Corners and St. Martins. The Waukesha & Watertown line of the same system runs west and the Milwaukee Northern Electric Railway north from the city.

Owing to the heavy, clayey nature of the soil over the greater part of the county, the roads in their natural condition are very bad in wet weather, and with the rapid increase in the use of the automobile it became necessary to build roads capable of withstanding the heavy traffic in the vicinity of the city. In the last few years nearly all the main roads and many of the crossroads have been surfaced. A report of the Milwaukee highway department published in January, 1916, indicates that nearly 100 miles of permanent road had been completed outside the city, 86 per cent being concrete, 7 per cent asphalt, 2 per cent brick and block, and 5 per cent macadam. The cost is met by direct taxation, about one-third being borne by the State. About \$2,000,000 has been expended. The road improvements have had a marked effect in increasing land values.

The city of Milwaukee is the chief market for all garden crops and many other products, such as milk, butter, meat, hay, grain, potatoes, etc. Sugar beets, some of the milk, cabbage, and other products are shipped to outside markets.

CLIMATE.

The climatic conditions prevailing in Milwaukee County are characteristic of a considerable region in eastern and southeastern Wisconsin immediately bordering Lake Michigan. The mean annual precipitation as reported by the Milwaukee station is 31.40 inches; the total rainfall for the driest year as given by the Weather Bureau is 18.69 inches, while the total for the wettest year is 50.36 inches.

This rainfall is, as a rule, fairly well distributed throughout the year, and especially during the growing season when it is most needed. Frequently, however, there are years when periods of dry weather alternate with periods of unusually heavy rainfall. These may continue from one to four weeks and occasionally longer. Observations made by the Weather Bureau station at Madison, where the rainfall conditions are very similar, covering a period of 30 years from 1882 to 1911, show that there are on the average three 10-day periods in each growing season in which the rainfall is so light that crops on a reasonably heavy soil suffer from lack of moisture.

The average date for the last killing frost in the spring in Milwaukee County is given by the records as April 27, and the average date of the first killing frost in the fall is given as October 10. This gives a growing season for Milwaukee County of approximately 166 days. The date of the latest killing frost recorded for the spring in Milwaukee County is May 29, and the date of the earliest killing frost in the fall is given as September 25.

The influence of Lake Michigan is quite marked in this county. The large body of water has the effect of delaying the opening of spring, but when warm weather finally begins it has a tendency to keep climatic conditions more uniform than in sections remote from large bodies of water, so that in this region summer frosts and early fall frosts are very rare. While the number of days between killing frosts is 166, as given, there is a considerable period after the last killing frost in the spring and before good growing weather begins during which the temperature is relatively low, and when such crops as corn will make but little progress. The land immediately bordering the lake and for some 5 or 10 miles back is for this reason not so well adapted to corn as land lying in the same latitude but farther inland. The influence of the lake accounts for more cool nights than are found in the interior of the State, and this of course is not conducive to the rapid growth of corn.

The mean annual temperature of the Milwaukee station is 45.3° F. The highest temperature recorded is 100°, and the lowest -25°.

The following table is compiled from the records of the Weather Bureau station at Milwaukee:

Normal monthly, seasonal, and annual temperature and precipitation at Milwaukee.

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1901).	Total amount for the wettest year (1876).
	° F.	° F.	° F.	Inches.	Inches.	Inches.
December.....	26.0	63	-22	1.92	1.69	2.16
January.....	19.8	61	-25	2.01	1.33	4.39
February.....	21.9	60	-24	1.89	1.92	3.63
Winter.....	22.6	63	-25	5.82	4.94	10.18
March.....	30.9	81	- 8	2.67	3.62	5.29
April.....	41.8	86	12	2.70	.47	2.83
May.....	53.6	94	25	3.42	1.75	8.54
Spring.....	42.1	94	- 8	8.79	5.84	16.66
June.....	63.5	98	38	3.67	1.12	4.76
July.....	69.7	100	47	3.01	2.03	4.39
August.....	68.7	98	42	2.82	1.50	5.52
Summer.....	67.3	100	38	9.50	4.65	14.67
September.....	61.5	96	25	2.92	1.86	3.66
October.....	50.2	88	15	2.39	.65	1.62
November.....	36.1	73	-14	1.98	.75	3.57
Fall.....	49.3	96	-14	7.29	3.26	8.85
Year.....	45.3	100	-25	31.40	18.69	50.36

AGRICULTURE.

The type of agriculture in Milwaukee County from about 1830 to 1850 was general farming. Land was cheap, the population was scattered, and the prices received for farm products were much lower than at present. Grain, hay, and live stock were the chief products. By 1860 wheat, oats, and corn had become the important crops. The first cargo of wheat is said to have been shipped from Milwaukee in 1841. With the increase in population in the county, both urban and rural, the demand for garden products became greater, the price of land advanced rapidly, and the number of farms increased, with a decrease in the average size. Owing to low prices and decreased yields, wheat production steadily declined after about 1870, while the production of market-garden and orchard crops increased. Small market gardens and truck farms in recent years have taken the place of the larger dairy and general farms near the city of Milwaukee. There has also been an increase in the number of tenant farms.

At the present time, aside from trucking and market gardening, the agriculture of the county consists of combined general farming and dairying. Special crops, such as cabbage, sugar beets, or potatoes, are grown by many farmers, but a majority depend mainly upon the products of the dairy, and most of their crops are produced for feeding live stock.

There are only three creameries in operation in the county, two of which are in Milwaukee, and most of the milk and cream is hauled or shipped to this city and a large part of it is consumed as fresh milk. Many farmers sell whole milk, others separate the cream and sell it or make butter, which is sold in the city. The advantage of the latter method is that the young calves can be raised on the farm, while with the former the calves must generally be disposed of and cows bought to maintain the herd. Small quantities of hay and grain and small numbers of calves and hogs are sold by these farmers.

The following table, compiled from the 1910 census, gives the number of live stock in the county and the sales of farm animals, by classes:

Number of domestic animals sold or slaughtered and number on farms and ranges.

Domestic animals on farms and ranges :		Domestic animals sold or slaughtered :	
Milch cows -----	11, 131	Calves, sold or slaughtered----	6, 093
All other cattle -----	3, 633	Other cattle, sold or slaugh-	
Horses-----	6, 679	tered -----	3, 810
Hogs -----	7, 241	Horses and mules, sold-----	188
Sheep-----	367	Swine, sold or slaughtered----	7, 461
		Sheep and goats, sold or slaugh-	
		tered -----	80

In the 1910 census oats is reported as the leading grain crop, with a production of 548,110 bushels from 15,368 acres. Corn is reported on 10,015 acres, with a production of 397,882 bushels; barley on 3,668 acres, with a production of 112,089 bushels; and rye on 1,234 acres, with a production of 24,448 bushels. Wheat is reported on somewhat less than 500 acres, producing about 10,000 bushels. Tame and cultivated grasses are reported on 28,808 acres, producing 43,531 tons of hay, and about 4,500 acres are reported in wild grasses and forage crops, with a production of about 12,000 tons. Potatoes occupied 6,905 acres, with a production of 803,595 bushels, and all other vegetables a total of 4,400 acres. There were 571 acres devoted to sugar beets, producing 6,948 tons. A total of 77,799 apple trees and about 3,000 grapevines are reported in the county. Strawberries are grown on about 100 acres.

The following table gives the value of the various farm products, as reported in the 1910 census:

Value of farm products, arranged by classes.

Product.	Value.	Product.	Value.
	<i>Dollars.</i>		
Cereals.....	588,502	Live stock and products:	<i>Dollars.</i>
Other grains and seeds.....	19,442	Animals sold and slaughtered.....	346,498
Hay and forage.....	642,359	Dairy products, excluding home use.....	675,178
Vegetables.....	853,902	Poultry and eggs.....	188,447
Fruits and nuts.....	67,397	Wool, mohair, and goat hair.....	340
All other crops.....	358,228	Total value.....	3,740,293

The garden crops are of many different kinds. Among the most important products are celery, berries, lettuce, radishes, onions, melons, sweet corn, asparagus, tomatoes, cabbage, cauliflower, cucumbers, and peppers. With the improvement of the roads, gardening is spreading to cheaper and more favorable soils and into areas 15 to 20 miles distant from Milwaukee. The products are hauled by team or motor and sold at the public markets to wholesale produce dealers and commission merchants, or peddled to regular customers in the city. The interurban railways run express cars which carry milk and garden produce to the city. From Hales Corners the cost is 20 cents per hundred pounds, and crates, cans, etc., are returned free to the owner's nearest station. Records in Milwaukee show that in the months of May, June, July, August, September, and October, 1916, a total of 18,357 loads of products was delivered to the public markets. The estimated value of each load is \$35.

A general recognition of the adaptation of the various soils to certain crops is represented by the local grouping of the soils into three classes—celery land, garden soil, and clay soil. The drained Peat is the soil referred to as celery land, the sandy terrace soils and the dark-colored soils as garden soil, and the general upland clay and silty clay loam, which are used for dairying and general farming, as clay soils.

With the exception of trucking and market gardening, the most specialized agriculture is the production of celery, sugar beets, and cabbage. The sugar beets and cabbage are generally grown on the larger dairy farms as cash crops, while celery growing is a separate industry. The young celery plants are grown in beds under glass, transplanted by hand to shallow trenches made in the Peat field, and the rows are gradually hilled or ridged up as the plants develop. The young cabbage plants are grown in open beds and transplanted in rows, generally with the aid of a planter, and are merely hoed and cultivated until mature. Fifteen to twenty-five tons of cabbage per acre is considered a good yield. Sugar beets are often grown in cooperation with a beet-sugar company, the nearest one being at

Menominee Falls in Waukesha County. Under a labor contract the seed and all hand work, such as hoeing, weeding, thinning, topping, and loading, are provided by the sugar company for \$21 per acre, while the farmer does all team work, such as plowing, seeding, cultivating, and hauling to the shipping point. Fifteen to twenty tons per acre is considered a good yield.

Most of the farms in the county have good houses, barns, and other buildings, and these are well cared for. In general, the best improvements are found in the northern half of the county. Silos are in general use in all parts of the county. On most of the general farms from 3 to 5 horses and 5 to 30 head of other stock are kept.

A number of farms have buildings somewhat resembling silos, but not so high and of greater diameter, for the storage of dry distillers' or brewers' grains. This product is used quite extensively, especially in the southern half of the county, as a supplementary feed for cattle and hogs. Most farmers haul the grains in a wet condition direct from the brewery or distillery in a large, tight box or a large barrel, of a capacity four or five times that of an ordinary barrel, and mounted on wheels. From 85 cents to \$3.20 per load is paid for this wet grain mash, depending upon the size of the container.

A common rotation on the dairy and general farms consists of hay 2 years, corn 1 year, and grain 1 year, with perhaps another cultivated crop 1 year. Where alfalfa is grown—and this crop is being gradually introduced—such a rotation is necessarily altered or abandoned, as alfalfa occupies the land for several years. Alfalfa is not yet grown generally or in large quantities, although it is said that little trouble is experienced in getting a good stand.

Only small quantities of commercial fertilizer are used in the county, most of that purchased being used in the production of flowers and other greenhouse crops. Most of the gardeners use manure hauled from the city.

It is difficult to obtain farm labor, and the cost is rapidly increasing. As much as \$35 to \$45 a month with board is sometimes paid for good farm hands. Much of the gardening and the celery and sugar-beet handwork is done by women, girls, and boys, usually members of the farmer's family.

The 1910 census reports a total of 2,443 farms in the county, averaging 47 acres in size. About 77 per cent of the area of the county is in farms, and of the farm land about 85 per cent, or 40 acres per farm, is reported improved.

Somewhat over one-third of the farms in the county are operated by tenants. The rent varies from \$4 to \$10 or \$12 an acre, depending upon the location of the land and the kind of farming practiced. The higher price is paid for the best garden land.

Land varies widely in value, ranging from \$100 or \$125 in the remote parts of the county to \$300, \$400, and even \$1,000 an acre for garden and celery land near the city.

SOILS.

Milwaukee County lies entirely within the glaciated area, and the surface formation consists of glacial deposits, ranging in thickness from a few feet to almost 200 feet. The soils have been derived, through weathering, from the drift materials, either in the position in which they were left by the ice or after transportation and redeposition by water.

With the exception of a small strip along the lake shore north of Milwaukee, the county is covered by drift deposited during the late Wisconsin stage of glaciation. This material was laid down in long gentle ridges parallel to the lake shore, with intervening narrow lowland belts and inclosed depressions, which exist as poorly drained areas and marshes. A study of the rock fragments found in the drift shows that 80 to 90 per cent is of limestone similar to the rocks underlying the drift. The remaining 10 to 20 per cent is composed of rock fragments wholly foreign to this part of Wisconsin. This small quantity of foreign material is made up of rocks brought from localities farther north and similar to those now exposed in the Lake Superior region, including Archaen crystalline rocks and the older sandstones and quartzites. The drift as originally deposited was for the most part unassorted and consisted of a blue, gray, or brown clay or silty clay in which sand, gravel, and bowlders of various sizes were embedded. It was highly calcareous, being derived largely from limestone.

Since the final recession of the ice this material has been subjected to the processes of weathering, giving rise to productive soils. The principal changes that have taken place are the leaching from the surface soil of the lime and other readily soluble constituents, and the incorporation of organic matter. Leaching has proceeded so far in many places that the surface soil is neutral or even acid. In most cases, however, there is a larger quantity of lime in the subsoil. The color of the upper part of the drift below the dark surface soil has been changed to a yellowish brown by oxidation. The surface soil has been darkened to a greater or less extent by the incorporation of organic matter. The drift soils are classed with two soil series—the Miami and the Carrington.

North of Milwaukee, lying between the Milwaukee River and the lake shore, there is a deposit of red material which differs strikingly from the other surface deposits of the county. The exact time and

manner of its deposition has not been fully determined. Its position overlying the drift and stratification in places indicate deposition in comparatively still water, but the source of the red material is not known. The thickness of this deposit varies from about 1 foot to 80 feet, with an average of about 25 feet. It occurs as a series of broad, gently undulating ridges. The unweathered material is a silty clay varying in color from light red to brownish or purplish red. In places many boulders are present, but as a rule these are less abundant than in the other surface materials of the county, and over considerable areas they are rarely encountered. Weathering does not extend to so great a depth as in the other materials, and organic matter does not seem to accumulate so rapidly in the surface soil. The soils of two series, the Kewaunee and Superior, are derived from this deposit.

The terrace soils are principally derived from deposits that were laid down as outwash plains by swollen streams from the melting glaciers. The most extensive terraces occur along Milwaukee River just north of Milwaukee. Similar terraces border other large streams in the county. The surface covering of the terraces ranges from a clay loam to sand, beneath which lie coarser materials. During the ice invasion some areas, principally along stream valleys, were ponded by the drift, and the lowlands thus formed were filled at the time or later by alluvial material. Through work of streams these valleys have been trenched and the remnants left as well-drained terraces or only partially drained areas and poorly drained tracts or marshes where more or less vegetable matter has accumulated. Several series of soils are represented.

The various soils are grouped, on the basis of origin and formation, color, topography and drainage, and other features, into soil series. The series is subdivided into types on the basis of texture. Sixteen types, included in nine series, exclusive of Peat, are mapped in Milwaukee County.

The soils of the Miami series are grayish brown, and the subsoils yellowish brown. The subsoils are heavier in texture than the soils, but the lower subsoils and substrata may be gravelly and sandy. These soils are derived from drift, and boulders, mainly of limestone, occur in the soil and subsoil. The surface soil may be neutral or even slightly acid, but the subsoil usually is calcareous. In this county five types are mapped, the fine sandy loam, loam, silty clay loam, gravelly clay loam, and clay loam.

The soils of the Clyde series are dark gray or dark brown to black; the subsoil is gray or drab, mottled with yellow. The Clyde soils are poorly drained and occur along streams and marshes within areas of

the Miami series. They represent glacial-drift material reworked in part by streams and weathered under poor conditions of drainage. In this county the loam and clay loam types are mapped.

The soils of the Carrington series are dark brown to black. The subsoil is yellow to light brown. The series is derived by weathering from glacial till. The topography is undulating to rolling. Neither the soil nor the subsoil is highly calcareous. The series is represented in this county by a single type, the silt loam.

The soils of the Kewaunee series are red to reddish brown, and the subsoil is red. The series is derived from red glacial material, probably reworked after deposition in a lake. The topography varies from undulating to rolling, and drainage is good. Only one member of this series is mapped, the clay loam.

The Superior series differs from the Kewaunee only in having a more nearly level topography and consequently poorer drainage. Only one type, the fine sandy loam, is encountered in this county.

The soils of the Poygan series are black. They contain large quantities of organic matter. The subsoil is red and similar in character to that of the Kewaunee series. As a rule, these soils are poorly drained. In this county the series is represented by only one type, the clay loam.

The Fox series includes grayish-brown soils with yellow or yellowish-brown subsoils, heavier in texture than the soils. Layers of sand and gravel, composed mainly of limestone, often occur below about 30 inches. These soils occupy level terraces. They lie above overflow, and drainage usually is good. In this county the Fox fine sandy loam and silt loam are mapped.

The Waukesha soils are dark brown to almost black, with light-brown or yellow subsoils. Layers of sand and gravel are encountered in places in the deep subsoil or substratum. The soils of this series occur on level or gently undulating terraces and are well drained. The sandy loam and loam types are mapped in Milwaukee County.

The Plainfield series includes brown surface soils with light-brown sandy and gravelly subsoils. These are productive terrace soils, but are somewhat droughty in very dry seasons. The Plainfield fine sand is mapped in this area. It is not typical, but is made to include all the sand areas in the county.

Peat, as mapped in this county, consists of a dark-brown to black spongy mass of organic matter made up of partly decayed vegetation. The peaty material varies greatly in depth, and a shallow phase of the type is separated. The depth of the peaty material in the shallow phase ranges from about 3 to 18 inches; in the typical areas it is more than 18 inches deep.

The following table gives the name and the actual and relative extent of each soil type mapped in Milwaukee County:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Miami silty clay loam.....	55,296	37.7	Carrington silt loam.....	1,408	.9
Level phase.....	2,752		Clyde loam.....	1,152	.7
Miami clay loam.....	38,528	30.3	Miami gravelly clay loam.....	1,088	.7
Level phase.....	8,384		Waukesha loam.....	1,024	.7
Clyde clay loam.....	19,392	12.6	Fox fine sandy loam.....	832	.5
Kewaunee clay loam.....	9,280	6.0	Fox silt loam.....	576	.4
Miami loam.....	5,248	3.4	Superior fine sandy loam.....	448	.3
Peat.....	2,880	2.2	Poygan clay loam.....	384	.2
Shallow phase.....	448		Plainfield fine sand.....	64	.1
Miami fine sandy loam.....	3,200	2.1			
Waukesha sandy loam.....	1,856	1.2	Total.....	154,240

MIAMI FINE SANDY LOAM.

The surface soil of the Miami fine sandy loam consists of 8 or 10 inches of grayish-brown to yellowish-brown fine sandy loam overlying yellowish-brown, sticky sandy clay loam or sandy loam. Gravelly sandy loam or sandy clay loam is encountered at a depth of 24 to 30 inches. The gravel occurs at or near the surface on the knolls, while in the depressions the surface soil is deeper and heavier than the average.

This type occurs in isolated areas in all parts of the county. The areas vary in size from a few acres to a square mile or more. The largest areas are near St. Francis, northeast of South Milwaukee, near and west of the Blue Mound Country Club, and just east of North Milwaukee. A sandy loam variation occurs along the Kinnikinnic River in the southwestern part of Milwaukee and along Underwood Creek, near the western county boundary.

The topography is generally undulating to rolling, and the drainage is good. On the sharpest knolls where gravel occurs near the surface crops may suffer from drought in continued dry spells, but the soil in general holds moisture well and produces good crops.

Most of the type near the more thickly settled sections is used for trucking and gardening, and is fairly well suited to that purpose, as it is easily worked and well drained. Its uneven topography and lack of organic matter, however, make it somewhat inferior to the Clyde and Waukesha soils. In addition to garden and truck crops, it produces good yields of sugar beets, oats, potatoes, and corn. Liberal applications of manure are needed on this soil. No commercial fertilizer is used.

MIAMI LOAM.

The surface soil consists of 6 to 10 inches of yellowish or brownish-gray loam to fine sandy loam, and the subsoil differs very little from the soil. At 24 to 30 inches the material is a more compact, sticky yellowish-brown sandy clay loam or loam. Gravelly sandy loam is often encountered at 30 to 36 inches. The soil is slightly variable, being a sticky sandy clay loam in some places and a more open sandy loam in others. Gravel sometimes occurs on sharp knolls, and boulders originally were quite numerous, though most of these have been removed. This soil is intimately associated with the Miami clay loam and silty clay loam, and in places the boundary is largely arbitrary.

The type occupies undulating to rolling knolls and narrow strips or projections of high land bordering streams and marshes. It occurs in isolated areas in all parts of the county. The topography is undulating to rolling, and the drainage generally is adequate. Some areas are forested, but the greater part of the type is under cultivation. Usually the general farm crops are grown, the type not being so well adapted to garden crops as other soils. Corn, oats, hay, potatoes, and clover are grown. Corn yields 50 to 70 bushels per acre, oats 40 to 50 bushels, potatoes 100 to 150 bushels, and hay $1\frac{1}{2}$ to 2 tons. Barnyard manure is used, but no commercial fertilizers are applied.

The selling price of this land varies widely. Some of it near Milwaukee sells for as much as \$600 to \$1,000 an acre, while in more remote areas it can be bought for \$100 to \$200 an acre.

MIAMI SILTY CLAY LOAM.

The Miami silty clay loam consists of dark grayish brown compact silt loam, 6 to 10 inches deep, and sometimes containing a relatively large proportion of very fine sand, resting on a subsoil of yellowish-brown clay loam. The material is reddish brown and contains limestone fragments below a depth of 24 to 36 inches.

This type covers practically all the south half of the county. Small areas in which the silty soil is about 8 inches deep and which might for that reason be mapped as a silt loam are included.

The topography in general is broadly undulating to rolling and the drainage is good. In a few places limestone rock occurs at 5 to 10 feet below the surface, but it is usually much deeper. Some stony spots occur in the southwestern part of the county and are indicated by symbols. In the southeastern corner of the county the land is said originally to have been stony, but the stones have largely been removed and only a few boulders remain on the surface.

Most of the type in its native state was forested with a heavy growth of hardwood, with "oak openings," or areas of scattered trees, in places. The timber remains only in small woodlots, and practically all the type is under cultivation.

The Miami silty clay loam is used mainly for dairying and general farming, but along Kilbourn and New Roads and Howell Avenue south from Milwaukee, and also along Janesville Plank and Loomis Roads considerable gardening is done. Hillside slopes, where the soil is often slightly loamy, sandy, or gravelly, and small strips of darker soil at the heads of drainage ways or bordering creeks and marshes, are preferred for the garden and truck crops. The farms are generally smaller and the land higher priced along these main roads.

On the dairy farms the most important crops are corn, barley, oats, hay, clover, and potatoes, with some alfalfa. Corn yields 80 to 100 bushels, oats 40 to 60 bushels, and potatoes 100 to 150 bushels per acre. Most of these crops are fed to the cows. The cash products include milk and butter, calves, hogs, and small quantities of grain, corn, and hay.

The crops are grown in rotations, the usual plan being as follows: (1) Clover hay, (2) clover and timothy hay, (3) corn or potatoes, and (4) grain, seeding the land to clover and timothy. Barnyard manure is relied upon to maintain the soil in productive condition. Some of the farmers combine dairying and gardening, keeping a few cows and raising some garden crops with enough field crops to feed the stock.

Land of this type varies widely in price, garden farms along the main roads selling for \$200 to \$500 an acre, while dairy farms and lands in more remote areas sell for \$100 to \$200 an acre, depending upon improvements, character of the surface, and conditions of the land.

Miami silty clay loam, level phase.—The surface soil of this phase consists of a grayish-brown heavy silt loam or silty clay, underlain at 6 to 10 inches by yellowish-brown clay loam. A sandy gravelly clay or sandy loam is encountered at 30 to 40 inches. The topography is very gently undulating to level. This phase does not include so much wet land as the level phase of the Miami clay loam, and as a whole is better drained.

Practically all the phase is under cultivation. It is used for the production of general farm crops. Corn yields 60 to 70 bushels, oats 50 to 70 bushels, and potatoes 150 to 200 bushels per acre. Alfalfa does well, although in wet seasons it may become weedy. Barnyard manure is used on this soil.

Land of this phase sells for \$125 to \$300 an acre.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Miami silty clay loam:

Mechanical analyses of Miami silty clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
312735.....	Soil.....	1.5	4.2	4.0	20.0	10.9	48.7	10.6
312736.....	Subsoil.....	.8	3.6	3.8	20.1	10.5	43.7	17.5

MIAMI GRAVELLY CLAY LOAM.

The Miami gravelly clay loam is somewhat variable in texture. The soil prevailingly is a grayish-brown or yellowish-brown, sticky or compact clay loam or sandy clay loam, containing varying quantities of sand and gravel. The subsoil is generally a compact clay loam or sandy clay loam carrying some gravel. Gravelly sandy loam occurs in places at 20 to 36 inches, and in some areas gravel is strewn thickly over the surface.

Most of the type occurs in a nearly continuous, gravelly morainic area extending from Lake Michigan, one-half mile north of Cudahy, in a northwesterly direction through St. Francis to west of Bay View. Another area lies south of the Menominee River, near the west end of the viaduct just west of Milwaukee. A few small areas occur in other parts of the county. Areas of sandy gravelly loam, too small to be mapped separately, are included with this type. They occur on small, scattered knolls in the moraine south of Bay View.

The topography is generally undulating to rolling or bumpy, and the drainage is good to excessive.

Areas of this soil near the city are used both for gardening and for the production of the general farm crops. The soil is very productive. It is often rather difficult to work because of the gravel, and much of it farther removed from the city is used for pasture or woodlots. Near Milwaukee a number of gravel and sand pits are worked in areas of this type.

MIAMI CLAY LOAM.

The Miami clay loam consists of 4 to 8 inches of grayish-brown, compact clay loam or silty clay loam, overlying yellowish-brown to reddish-yellow heavy clay loam or clay. Yellowish-brown sandy clay loam or loam occurs at depths of 22 to 30 inches. From 30 to 36 inches the material contains some gravel and often considerable sand. On the knolls the gravel may be nearer the surface with a

sticky gravelly clay or loamy clay surface soil. Depressions and level areas have a deeper silty surface soil.

This soil as mapped includes a large part of the upland of the north half of the county. It includes the undulating to rolling upland south of the Menominee River and the more rolling ridges west of Wauwatosa and along the east side of the Underwood Creek Valley.

Areas to the south, where the surface silty material is uniformly deeper over the clay loam subsoil, are mapped as the Miami silty clay loam. In general the clay loam occupies the more rolling ridges, but the separation of the clay loam and silty clay loam types is difficult, and the boundary between the two is in many cases largely arbitrary. The difference in the soil is most noticeable in wet weather when the rolling ridge land, where the surface silty clay is shallower, often becomes difficult to work. In dry weather the difference is not so marked and the separation of the types on the basis of the depth of the silty surface layer is difficult.

The Miami clay loam is generally well drained, but in continued bad weather it becomes sticky and is difficult to handle.

This is an extensive and highly developed type. The soil is strong and productive, and except for small woodlots it is practically all under cultivation. The original forest growth consisted of oak, maple, elm, ash, beech, and some hickory and walnut, but little of the valuable timber is left. The type is used mainly for dairying and general farming combined. In trucking and gardening sections and along some of the main roads leading into Milwaukee garden crops are produced. The general farm crops include corn, oats, barley, hay, potatoes, cabbage, and sugar beets, with some alfalfa.

Corn yields 80 to 100 bushels, oats 60 to 70 bushels, barley 40 to 50 bushels, potatoes 125 to 150 bushels, sugar beets and cabbage 15 to 20 tons, and alfalfa 3 to 4 tons of hay per acre. Alfalfa is not grown on many farms, but its acreage is increasing. No great difficulty seems to be experienced in getting a good stand where proper methods are employed. Cabbage, potatoes, and sugar beets are the cash, or special, crops on this type. Little hay, corn, or grain is sold, most of these crops being fed to cows, hogs, and other stock.

Barnyard manure is applied to this soil, and manure spreaders are in common use. Very little commercial fertilizer is used. The type is improved by increasing the organic-matter supply by growing and plowing under legume crops such as clover or alfalfa.

This land sells for \$200 to \$400 or more an acre, depending upon location and improvement.

Miami clay loam, level phase.—This phase includes areas of the Miami clay loam having a nearly flat topography. The soil consists of 6 to 8 inches of grayish-brown silty clay loam overlying a

yellowish-brown or mottled yellow clay or clay loam. Sandy clay loam with some limestone fragments is reached at about 30 to 36 inches.

This phase occupies irregular areas in the broad valleys or depressions between the ridges, and generally borders a stream or marsh. It occurs mainly in the north half of the county.

The surface is generally flat, and while some areas have fair drainage, others after periods of wet weather remain much too wet for cultivation. The poor drainage is partly due to seepage from surrounding higher land.

Practically all this phase is cultivated or pastured, about the same crops being grown as on the main type. Yields are somewhat lighter, and cultivation is often delayed in the more level areas. For its improvement this soil requires drainage, generally by means of tiling, and in some places liming is essential.

CLYDE LOAM.

The surface soil of the Clyde loam consists of dark-brown to black fine sandy loam, about 8 to 12 inches deep. The upper subsoil is a grayish-yellow or mottled sandy loam containing considerable gravel. The material below 24 to 30 inches is variable, but is generally a sticky clay or yellowish sandy clay loam.

This type occurs in detached areas in all parts of the county in association with the poorly drained areas of the Clyde clay loam bordering streams and marshes. It has a small total area.

The topography is level, but the type as a rule has a slightly higher position and is better drained than the associated clay loam, so that a greater proportion is under cultivation. It is better suited to gardening than the clay loam type. Besides its higher percentage of sand it contains more organic matter, which makes cultivation easier than in case of the clay loam. Many different garden crops, including onions, potatoes, melons, and tomatoes, are grown. No commercial fertilizer is used, but barnyard manure is applied in large quantities.

This land sells for \$150 to \$600 an acre, depending mainly upon its location.

A small area of sandy loam is included with this type. This soil differs from the loam only in texture and in having better drainage. It occurs on the terrace bordering the Milwaukee River west of Whitefish Bay, and is a valuable soil for market gardening.

CLYDE CLAY LOAM.

The Clyde clay loam consists of 12 to 16 inches of dark-grayish or black sticky clay loam to silty clay loam overlying a blue or mottled

yellow compact clay loam. In places the mottled subsoil contains some fine sand and gravel below a depth of 30 to 36 inches.

This soil occurs in shallow depressions in the upland and as long strips bordering the streams and marshes. Areas varying in size from 3 or 4 acres to a square mile are found in various parts of the county. Of the larger areas, one occurs a mile west of Whitefish Bay, one just west of North Milwaukee, one just west of Cudahy, and another near the southwest corner of the county south of Heelyton.

This type is low and generally flat. The drainage is generally poor, and practically all the land in its natural state is too wet for cultivation. The soil is often tile-drained and used for gardening, and is highly valued because of its high content of organic matter. In a few instances, especially in the southern part of the county, dredged drainage ditches are used, and field crops are grown.

In dry seasons the soil retains moisture well and crops are not so likely to suffer for lack of moisture as on the sandy soils. The type, especially in wet seasons, is cold and late in spring and can not be worked soon after rains.

Many different garden crops are grown, and good yields of corn, hay, sugar beets, and potatoes are obtained where the land is drained. Most of it is undrained, and supports a vegetation consisting mainly of marsh grass, brush, and large elm and ash trees. Such areas are used largely for pasture or for growing hay.

The selling price of this land varies greatly, depending mainly upon location. Some farms sell for \$500 to \$600 an acre, while much of the type farther from Milwaukee and from good roads can be bought for \$100 to \$200 an acre.

Improvement of this soil in nearly every case depends primarily upon tile drainage; when drained it is a productive and valuable soil for gardening or for general farming. Farmers in other sections have tiled this type of soil at a cost of \$17 to \$25 an acre. The yields on tile-drained areas are considerably larger than where such improvement has not been made.

CARRINGTON SILT LOAM.

The Carrington silt loam consists of 10 to 16 inches of dark-brown or black heavy silt loam overlying a buff or grayish-brown clay loam. The subsoil contains small quantities of fine sand and gravel, and is light yellow below about 24 to 30 inches. White streaks of limy or marly material are present in a few places in the deeper subsoil.

This soil is mapped in the southern part of the county. The area south of Heelyton is an extension of a much larger area in Racine County to the south. The type has a small total area in Milwaukee County.

The topography is undulating to gently rolling. The type includes lower-lying areas near the streams and steep slopes rising to

the highland. Although there is considerable variation in the topography, the drainage is generally deficient, and tile drainage is required over a large part of the type to bring it to its highest state of productiveness. Small grassy swales and depressions are numerous, and because of the dense clay subsoil and the lack of natural drainage outlets, the type includes considerable wet and cold waste land that can be reclaimed only by drainage. Even land with considerable slope may be too wet for satisfactory cultivation. Probably 50 per cent of the type would be benefited by the installation of tile drains.

Notwithstanding the deficient drainage of this type, it is a productive and valuable soil. All of it is used for some purpose, the wet land for hay or pasture. Little if any of the original forest remains.

General dairy farming is practiced, and some truck crops are grown. The most important crops are corn, barley, hay, potatoes, and cabbage. Corn yields 60 to 100 bushels per acre, barley 25 to 40 bushels, hay about 2 tons, potatoes 100 to 150 bushels, and cabbage 12 to 15 tons.

A sufficient number of cows is generally kept on the farms to supply the cultivated land with barnyard manure. No commercial fertilizers are used either on the general farm crops or on the truck crops.

This land sells for \$75 to \$150 an acre, depending upon location, improvements, and drainage conditions.

For its improvement this soil is mainly in need of drainage and the addition of lime. Most of the soil is distinctly acid to litmus paper. This is due in part to poor drainage and in part to the high organic-matter content. Proper drainage and the application of 2 to 4 tons per acre of finely ground limestone should make this one of the most productive and valuable soils in the county.

KEWAUNEE CLAY LOAM.

The surface soil of the Kewaunee clay loam consists of a grayish-red or reddish-brown clay loam from 3 to 6 inches deep, containing a fair percentage of organic matter and varying quantities of gritty sand or fine sand. The subsoil is a red, sticky, compact clay loam, which continues throughout the 3-foot section and contains varying quantities of limestone fragments and gravel. Where the land is slightly undulating the soil of the knolls has a pink or reddish color, while grayish material predominates in the level areas. The knolls and undulating areas, although having better drainage, are often as hard to work in wet seasons as the level areas where the surface material has greater depth.

The Kewaunee clay loam occurs as a continuous body, lying mainly between Milwaukee River and Lake Michigan. This area is about

3 miles wide along the north county line and tapers rapidly to the south. At Whitefish Bay the area extends less than one-fourth mile back from Lake Michigan, but it widens again farther south. It is cut by the valley of the Milwaukee River. A small isolated area lies on the lake a short distance north of Cudahy.

Most of the type has a gently undulating topography. Along the east side of the Milwaukee River Valley the surface is distinctly rolling, and an abrupt bluff extends 100 to 120 feet down to the lake. A few deep ravines extend back one-half to 1 mile from the lake. Some areas of the type are nearly level. Shallow swales and narrow depressions occur along the drainage ways, and some small undrained depressions and flat areas occur, in which the surface has become dark from the accumulation of organic matter. This undrained soil, where of sufficient extent to be shown separately on the soil map, is classed with the Poygan clay loam. Drainage is poorest in the widest part of the area just below the north county line. The dense clay subsoil makes the soil rather cold and late, especially in wet seasons, where the topography is not distinctly undulating or rolling.

Practically all the type is under cultivation or used for pasture. The original forest growth consisted largely of beech, pine, and maple. The trees remaining in a few small woodlots are mainly oak and maple.

Grain, corn, and hay are the chief crops. Dairying is important. On some of the small farms a few cows are kept and butter is sold, while the larger farms with more cows sell whole milk. A number of farms, especially those including low areas of dark soil, produce truck crops to some extent. Cabbage, tomatoes, potatoes, and other garden crops are grown, although the soil as a whole is not well adapted to gardening, being too heavy to work easily and too slow in drying after rains.

Corn is not extensively grown, and in most years only the earliest varieties mature well, because planting in the spring is often delayed. Replanting is frequently necessary in wet seasons. Forty to fifty bushels per acre is considered a good yield of corn. Oats yield 30 to 40 bushels, potatoes 60 to 80 bushels, rye 15 to 20 bushels, timothy about $1\frac{1}{2}$ tons, and timothy and clover mixed $1\frac{1}{2}$ to $2\frac{1}{2}$ tons per acre. Irish potatoes are grown for home use, but the industry has not been developed on a commercial scale. The type is better adapted to other crops than to potatoes. Considerable difficulty is experienced in obtaining and keeping a stand of clover, and over some sections little clover is grown.

The Kewaunee clay loam is probably the most difficult soil in the county to cultivate, and it requires heavy stock and implements to handle it efficiently. When plowed too wet it is likely to puddle. On

the knolls of heavier soil large clods are sometimes turned up which are quite difficult to pulverize. The poorly drained areas are more difficult to handle than where the drainage is good. The best results are obtained where the land is plowed in the fall, but fall plowing is not always practicable. Stable manure is applied to this soil, but green manuring is not common, and no commercial fertilizer is used.

The most important problem which confronts the farmers on this soil is that of drainage. Before the best results can be obtained on the type as a whole, tile drains must be installed, even on gentle slopes where the drainage apparently is adequate. There is also a general need for definite crop rotation. A rotation that gives good results on land of this class is: First year small grains, such as oats, barley, wheat, or rye, seeded down to clover, with a little timothy mixed in it; second year clover, the first cutting being for hay and the second for seed; and third year mixed clover and timothy. The sod may be manured either before plowing in the fall or in the winter after the land has been plowed. The fourth year the land may be used for a cultivated crop, such as corn or a root crop.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Kewaunee clay loam:

Mechanical analyses of Kewaunee clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
312711.....	Soil.....	0.3	1.7	2.6	13.9	11.0	39.8	30.6
312712.....	Subsoil.....	.4	1.6	1.9	12.0	11.6	38.5	34.2

SUPERIOR FINE SANDY LOAM.

The surface soil of the Superior fine sandy loam, to an average depth of about 12 inches, usually consists of a brown or yellowish-brown fine sandy loam, the color becoming lighter with depth. The texture varies somewhat, and in local areas may be a sandy loam or sand. The upper subsoil has about the same texture as the soil, but a stiff red clay is encountered at depths of 20 to 40 inches.

This type occupies a strip about one-fourth mile wide along the Lake Michigan shore just south of Milwaukee. The topography is gently undulating and the soil is well drained, but the type holds moisture well because of its heavy clay subsoil.

Where cultivated, the Superior fine sandy loam is used for general farm crops. Much of it is used for building sites as the city limits are extended. It is considered a fairly good general-farming soil and is largely under cultivation. It is easy to till and responds readily to good treatment. Stable manure is applied, but no commercial fertilizer is used. Average yields of 40 to 65 bushels of

corn, 20 to 30 bushels of oats, 20 to 25 bushels of barley, 15 to 25 bushels of rye, and 100 to 125 bushels of potatoes per acre are obtained. Very little wheat and hay are grown.

The soil is generally in need of organic matter, which can be supplied effectively by supplementing the stable manure with green-manure crops, preferably clover or some other legume. Where the soil shows indications of acidity, the application of about 1,200 pounds of ground limestone per acre is beneficial. This type is better adapted to truck and small fruits, including strawberries, than to general farming. It is well suited to apple production.

POYGAN CLAY LOAM.

The Poygan clay loam consists of 6 to 14 inches of dark-brown to black, sticky clay loam with a mottled or bluish, tight clay subsoil which often grades into red heavy clay at varying depths below 3 feet. Large quantities of sand and some gravel are sometimes present in the subsoil, the material being a bluish gravelly clay or sandy clay below about 24 or 36 inches.

The narrow strip of this soil bordering Lake Michigan just south of Fox Point consists of a series of fans of clay loam eroded from gullies in the red clay above and deposited over the beach sand along the lake. A part of it is poorly drained, being kept wet by seepage. The type lies 3 to 15 feet above the lake level.

The Poygan clay loam occurs in scattered patches and is of small extent. It occupies depressions and poorly drained spots within the areas of the Kewaunee clay loam in the northeastern part of the county.

The material is largely of lacustrine origin. Owing to its low position and poor drainage, there has been a growth and decay of vegetation in the presence of moisture which accounts for its high organic-matter content and dark color. The surface soil frequently is slightly acid, but the subsoil is calcareous.

A small part of the type is cultivated to such crops as cabbage and beets. But little of it has been tilled. Most of the type is used for pasture or hay land.

FOX FINE SANDY LOAM.

The surface soil of the Fox fine sandy loam consists of 8 to 10 inches of dark grayish brown fine sandy loam. This overlies a yellowish-brown, sticky sandy clay loam. The subsoil becomes more compact at depths of 24 to 36 inches, where layers of gravel and sand are encountered. Some gravel is scattered over the surface.

This soil occurs in level or nearly level terrace strips along two or three of the streams. These strips are remnants of terraces built up by the swollen streams of glacial times. Most of the type occurs along the sides of Root River Valley in the western and southwestern

part of the county. It is mapped also near the Milwaukee River just northeast and east of North Milwaukee. It is not extensive in this county. The surface is nearly level or slopes gently toward the stream, and because of its elevated position the drainage of the type is generally good.

In the vicinity of North Milwaukee the Fox fine sandy loam is used largely for market gardening, but in the southwestern part of the county it is devoted mainly to general farming. This is considered a valuable soil. Corn yields about 100 bushels, potatoes 200 bushels, oats 60 bushels, and hay $1\frac{1}{2}$ to 2 tons per acre.

For general farming this land sells for \$150 to \$200 an acre. In the gardening section it often sells for higher prices.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Fox fine sandy loam:

Mechanical analyses of Fox fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
312733.....	Soil.....	1.4	6.1	9.2	32.6	11.1	31.1	8.4
312734.....	Subsoil.....	2.0	7.3	9.0	34.5	8.7	26.4	12.0

FOX SILT LOAM.

The Fox silt loam consists of 8 to 12 inches of grayish-brown silt loam, underlain by yellowish-brown, compact silty clay loam containing some gravel. Yellowish-brown sandy gravelly loam occurs at 24 to 36 inches or at greater depths.

As mapped, this type includes areas of loam, which are not sufficiently extensive to be mapped separately. The loam occupies the areas along Root River and the greater part of the area on Underwood Creek west of the State Fair Grounds. The surface soil consists of 8 to 12 inches of grayish-brown loam to silty loam, containing varying quantities of sand and some gravel. The subsoil is a yellowish or reddish-brown, sticky sandy clay loam or loam. A reddish-brown sandy gravelly loam occurs at 24 to 30 inches, and this is underlain by gravel and sand. The Fox silt loam occupies nearly level terraces bordering stream valleys. It occurs just west and southwest of Wauwatosa and in small areas along the Root River. The type is inextensive.

This soil is used mainly for general farming. It is not so well adapted to gardening as the sandier or darker colored soils, but is a productive and valuable soil for general farm crops. Corn yields 60 to 70 bushels, oats 50 to 70 bushels, and potatoes about 200 bushels per acre. Cabbage, barley, and alfalfa do well.

Land of the Fox silt loam type sells for \$150 to \$300 an acre, depending upon location and improvements.

WAUKESHA SANDY LOAM.

The Waukesha sandy loam consists of 8 to 12 inches of dark-brown sandy loam to fine sandy loam overlying yellowish-brown sandy loam or sand. The subsoil is variable, containing layers of coarse sandy loam with some gravel or fine yellow sand. In some places a sticky coarse sandy clay loam layer, 2 to 6 inches deep, is encountered at 20 to 30 inches. Sand and gravel are present in the deeper subsoil.

This type occurs along the streams as terraces lying 5 to 20 feet above the stream beds. The larger areas occur along the Milwaukee River in the vicinity of Silver Spring and west of Whitefish Bay. The soil is not extensive. The surface is nearly level. Being usually well elevated above the streams and having a porous, open subsoil, the type has good drainage. In prolonged dry periods crops suffer to some extent for lack of moisture.

Practically all the type is under cultivation. It is used for gardening, for which it has a high value, owing to its location near the city. On the whole this is one of the best trucking and gardening soils; while it has the disadvantage of a somewhat lower organic-matter content and water-holding capacity than some of the other trucking soils, it possesses certain advantages. It is easily worked, can be cultivated very early in the spring and almost immediately after moderate rains, responds quickly to manuring, and is quite easily kept free from weeds.

Practically all this soil is used for the production of garden crops. Two crops and sometimes three of the rapidly growing sorts may be grown on the same plot in a season. Many different vegetables are grown. The truck farms range in size from 3 to 20 acres. Very few of the farmers specialize, but grow a variety of crops. Some of the garden farmers practice a general rotation of field crops, such as corn, clover, potatoes, or grain, with garden or truck crops, while others produce truck crops continuously, varying the succession of crops in their various plots. Stable manure hauled from the city is applied to the land, usually at the rate of about 20 loads per acre. No commercial fertilizer is applied.

Some of this land sells for \$250 to \$400 an acre, but much of it on the main roads and lying near Milwaukee is held at \$600 to \$1,000 an acre.

WAUKESHA LOAM.

The Waukesha loam consists of a very dark chocolate brown to black or grayish-black fine sandy loam to loam, underlain at about 8 to 16 inches by a gray or yellowish sandy loam or sand. In places this sand is iron stained. Occasionally a thin layer of compact sandy clay, 1 inch to 6 inches in thickness, occurs at 18 to 30 inches from the surface. The deep subsoil is sandy or gravelly.

This type borders the Milwaukee River west of Whitefish Bay. It occupies terraces, and the topography is practically level. Very slight swells or knolls occur, on which the soil is better drained and slightly lighter in color than typical. In flat, poorly drained areas the soil is black.

The natural drainage, especially in that part of the type just west of Whitefish Bay, is generally deficient. Here the value of the land is greatly increased by tiling. In dry seasons the soil can be cultivated satisfactorily, but in wet seasons, owing to the flat topography and the accumulation of seepage from higher lands to the east, some parts of the type are too moist for good results with garden crops.

As mapped the Waukesha loam includes a small area of gravelly clay loam. This occupies a high terrace position. The soil consists of 6 to 10 inches of dark-brown to chocolate-brown, heavy gravelly clay loam, containing some coarse sand and overlying reddish chocolate brown, compact, sticky clay loam. Gravelly sandy clay loam, carrying coarse gravel, occurs at 24 to 36 inches, with layers of coarse gravel and sand in the deep subsoil. Small gravel one-half inch to 2 inches in diameter thickly covers the surface in places. The clay content of the surface soil makes it rather heavy for the best gardening conditions, and it does not dry out as quickly after rains as the more sandy soils about it, so that it is used more extensively for general farm crops than for garden and truck crops, which are produced extensively in this vicinity. Potatoes, corn, rye, oats, clover, alfalfa, and some truck and garden crops are grown. The soil is strong and productive.

The Waukesha loam, with the exception of the gravelly clay areas, is used for trucking, a wide variety of truck crops being grown. Horse manure hauled from the city is applied, but no commercial fertilizer is used.

The value of this type ranges from \$350 to \$1,000 an acre, depending mainly upon location, improvements, and value for gardening.

PLAINFIELD FINE SAND.

The Plainfield fine sand, as mapped in this county, includes all the sand areas. It occurs in only a few small bodies. Two areas, one at the mouth of Oak Creek opposite South Milwaukee, and the other just north of Fox Point, consist of deposits of beach sand. They occur as narrow strips of sand lying between the lake and the bluff. No agricultural use is made of these deposits.

Another area includes small knolls or ridges on the terraces west of the Milwaukee River and northwest of Whitefish Bay. The soil consists of yellowish-brown fine sand, and the subsoil is a yellow fine sand. Both soil and subsoil contain some gravel. This soil is used for trucking, to which it seems fairly well adapted, but it requires

heavy applications of manure and is subject to drought to some extent in dry periods.

Another small area of fine sand occurs between Bay View and St. Francis. The topography is nearly level. This area is used in part for gardening and in part for general farm crops. The soil is badly run down and in need of improvement.

PEAT.

Peat consists of dark-brown to black, spongy organic material derived from the partial decay of water-loving vegetation in wet areas. The material is finely divided as a rule and fairly well decomposed. It is 18 inches or more in depth. There are often thin mossy layers in the subsurface material which are less well decomposed. The subsoil, or bottom, of the undrained areas and marshes is generally a bluish, dense clay or mottled reddish and yellowish clay loam or sandy clay loam. The surface covering of organic material varies in depth. The extent of decomposition and the quantity of mineral matter mixed with it vary somewhat.

In a few cases this material might properly be mapped as Muck, but prevailingly it is well-decomposed, finely divided Peat. It may be slightly or even markedly acid to litmus paper. The only marl deposit encountered is in sec. 18, T. 6 N., north of the Beloit Road and near the Waukesha County line. This deposit is less than one-half acre in extent and consists of rather impure marl.

The Peat occurs in small depressions ranging from about 5 to 80 acres in extent. These areas are widely distributed through the county, and are especially numerous in the southwestern corner southeast of St. Martins. The Peat occurs also along stream courses, as in the area west of Carrollville in the southeastern corner of the county, drained by Oak Creek.

The Peat areas are generally marshy and support an open growth of grass or brush. Occasionally there is a growth of elm, ash, or tamarack trees.

Peat areas in many cases, especially near the city of Milwaukee, have been drained and used for growing truck crops, especially celery. Some of the oldest celery farms on the south side of the city have been used as building sites, and in some cases the growers have started new celery farms farther out. Celery has been grown for 40 years on the same field in some cases. Stable manure is used, as much as 30 to 40 loads per acre often being applied yearly. Onions, cauliflower, potatoes, cabbage, and garden vegetables are also produced and sold at the city markets.

Peat suitable for gardening sells for \$75 to \$200 an acre, depending upon location and improvement.

Peat, shallow phase.—In mapping Peat a separation is made on the basis of depth of the peaty material, and a shallow phase is separated. In this phase the clay subsoil is encountered at depths of 3 to 18 inches. In other respects the phase is like the main body of the type, although it often carries more mineral matter—silt, clay, and sand—and the organic material itself may be more thoroughly decomposed.

SUMMARY.

Milwaukee County is in the southeastern corner of Wisconsin, adjoining Lake Michigan. It has an area of approximately 241 square miles, or 154,240 acres.

The county comprises a series of broad, elongated ridges paralleling the shore of Lake Michigan. The surface in general is undulating to rolling. It rises toward the west and an elevation of 260 feet above the lake, or 840 feet above sea level, is attained in the western part of the county.

Milwaukee County was organized in 1836, and reduced to its present size in 1846. The total population, as reported by the census of 1910, is 433,187, of which about 9 per cent is rural. The density of the rural population is 168 per square mile. Milwaukee City, with a population of about 374,000, is the county seat.

Railroads and electric lines radiate in all directions from Milwaukee, and the county is well supplied with transportation facilities. The county road system is particularly good. Milwaukee is the chief market for the products of the county.

The growing season averages 166 days. The mean annual temperature is 45.3° F., and the mean annual rainfall 31.40 inches.

The agriculture of the county consists of general farming and dairying, trucking, and market gardening. The general crops, oats, barley, corn, hay, and alfalfa, are produced on the dairy farms. Special crops, such as sugar beets, cabbage, potatoes, celery, and onions, are grown on the truck farms and smaller dairy farms, and vegetables of all kinds are grown in the market gardens, located mainly in the vicinity of Milwaukee.

The farms, particularly in the northern part of the county, are well improved. In general, farming is in a prosperous condition and the average price of farm land in the county is well above the average price per acre for the State. The adaptation of the soil to certain crops is generally recognized, and some attention is given to crop rotation. Manure is commonly applied to cultivated land, but little commercial fertilizer is used.

According to the 1910 census, there is a total of 2,443 farms in the county, averaging 47 acres in size. About 77 per cent of the area of the county is in farms, and of the farm land about 85 per cent, or

40 acres per farm, is reported improved. Somewhat over one-third of the farms are operated by tenants. The average value of farm land is reported as \$197.49 an acre.

There is very little sandy soil in the county, about 90 per cent of the soil being heavier than loam. Nine soil series, including 16 types, together with 1 miscellaneous type, are mapped in this county. Of these the most important are the Miami soils, which cover over 74 per cent of the county. These are light-colored formerly timbered upland glacial soils, carrying considerable limestone material, especially in the subsoil. Five members of the Miami series are mapped—the fine sandy loam, loam, silty clay loam, gravelly clay loam, and clay loam.

The Clyde series is represented by two types, the loam and clay loam. These are dark-colored soils with poor drainage, occurring along the streams and in depressions within areas of the Miami soils. They are used for pasture, woodlot, and marsh-hay land in their natural condition and for garden crops where drained.

The Carrington series includes dark-colored prairie soils, similar in many respects to the Miami. Only one member of this series, the silt loam, is mapped.

The Kewaunee series includes the red glacial soil north of Milwaukee that has a gently rolling topography. One type, a clay loam, is mapped.

The Superior series is represented by one type, the fine sandy loam. This soil is derived from material deposited in water in glacial times, when the level of Lake Michigan was at least 100 to 125 feet above its present stage, and later slightly altered by glaciation. The soil is heavy and cold in the spring and is used only for general farming and dairying.

The Poygan series is represented by only one type, the clay loam. It is of small extent and is relatively unimportant.

The Fox series is represented by two members, the fine sandy loam and silt loam. It includes light-colored terrace soils. These are productive and valuable soils, but are not extensive in this county.

The Waukesha series includes the dark-colored well-drained limestone soils laid down by water as outwash areas or terraces and having stratified gravelly or sandy subsoils. In this county it includes two types, the sandy loam and loam. These soils are used for market gardening.

The Plainfield series is represented by a single type, the fine sand. This type is made to include all the sand areas mapped in the county.

Peat consists of an accumulation of decaying vegetable material overlying clay. Some of the Peat land has been drained and is used for celery culture, gardening, and general farming.

[PUBLIC RESOLUTION—No. 9.]

JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided,* That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]

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