PHOTO-MOSAIC SOIL MAP OF WISCONSIN

Soils information compiled by F. D. Hole

UNIVERSITY OF WISCONSIN–EXTENSION
GEOLOGICAL AND NATURAL HISTORY SURVEY

1977

LAKE SUPERIOR

MINNESOTA

MICHIGAN

IOWA

ILLINOIS

LAKE MICHIGAN

MAJOR SOIL LANDSCAPES

1. Silt loams, dark, deep: prairies, ridge tops and valley terraces. Southwest Wisconsin.
2. Silt loams, dark, moderately deep: prairies, ridge tops. Southwest Wisconsin.
3. Silt loams, deep: ridges and valleys near Mississippi River. Southwest Wisconsin.
4. Silt loams, moderately deep: ridges and valleys. Southwest Wisconsin.
5. Silt loams, dark, moderately deep: prairies, rolling to level. Southeast Wisconsin.
6. Silty clay loams, dark, moderately deep: prairies, rolling to level. Southeast Wisconsin near Lake Michigan.
7. Silt loams, moderately deep: rolling to level. Southeast Wisconsin.
8. Silty clay loams, moderately deep: rolling to level, over gray till. Southeast Wisconsin.
9. Loams and sandy loams: Kettle Moraine, rolling to hilly. Southeast Wisconsin.
10. Loams and loamy sands, dark: prairies, rolling to level. Central Wisconsin.
11. Loamy sands and sands: rolling to level. Central Wisconsin.
12. Loams over sandstone: hilly to gently rolling. West central Wisconsin.
13. Loams over sandstone and shale: level to gently rolling, somewhat wet. Central Wisconsin.
14. Loams over pink loam or limestone: rolling to level. Northeast Wisconsin.
15. Silt loams, dark, moderately deep: gently rolling. Northwest Wisconsin.
16. Silt loams, shallow: hilly to level. Northeast and North central Wisconsin.
17. Silt loams, moderately deep: level to rolling. North central Wisconsin.
18. Silt loams, moderately deep: undulating, somewhat wet. North central Wisconsin.
19. Silt loams, shallow: undulating, somewhat wet. North and north central Wisconsin.
20. Loams and sandy loams, deep, with stones: hilly to level. North and north central Wisconsin.
21. Loamy sands and sands, deep, with some stones: hilly to level. North Wisconsin.
22. Silt loams, moderately deep: rolling to level over reddish brown clayey drift. East Wisconsin.
23. Silty clay loams, moderately deep: rolling to level over reddish brown clayey drift. North Wisconsin.
24. Silt loams, loams and sands on river bottoms: level. Mostly in southwest Wisconsin.
25. Silty clay loams to sands: wet, except where artificially drained, level. In low places throughout the state.
26. Peat and muck soils: wet, except where artificially drained. In low places throughout the state.

W. Water: lakes and rivers.

THE PHOTO-IMAGE

Soil information is shown on a photographic mosaic compiled from ERTS (Earth Resources Technology Satellite) imagery taken between July 23 and October 31, 1972. The imagery is in the visible red spectrum (0.6 to 0.7 micrometers) and is based on an Albers Equal Area Projection. The mosaic was produced by NASA Goddard Space Flight Center and USDA-Soil Conservation Service.

0 10 20 30 40 50 Miles

0 10 20 30 40 50 Kilometers

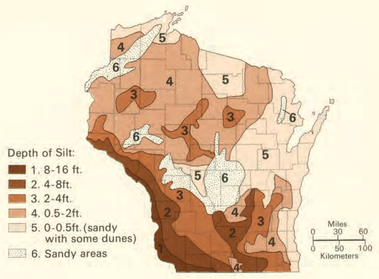
Scale 1: 1,000,000 (1 inch = about 16 miles or 26 kilometers)

Applications of information shown on this photo map are discussed on the reverse side

UNIVERSITY OF WISCONSIN MADISON
CARTOGRAPHIC LABORATORY

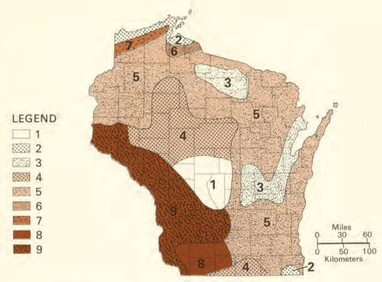
Map 1. BEDROCK GEOLOGY

The oldest rocks, called Precambrian, include igneous rocks, such as granite, and associated metamorphic rocks (0 where data are sparse, 1 elsewhere), trap rock (2), quartzite (3), and sandstone (4). Over that lies Cambrian sandstone (5), Prairie du Chien Dolomite (6), Ancell sandstone (7), Sinnipee Dolomite (8), Maquoketa Shale (9), Silurian dolomite (10), and Devonian shale (11).



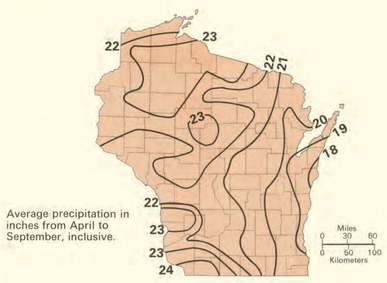
Map 2. WIND-DEPOSITED SILT (LOESS) AND SAND

Large quantities of silt (loess) were blown in by dust storms during the ice age, from the Mississippi River flood plain north-eastward onto uplands. In sandy areas (6) the silt blanket did not stay but was blown still further probably because of erodibility of the sandy terrain. Soils that developed from the fertile silt (areas 1 through 5) have good capacities to hold water and nutrients for the benfit of plant growth.



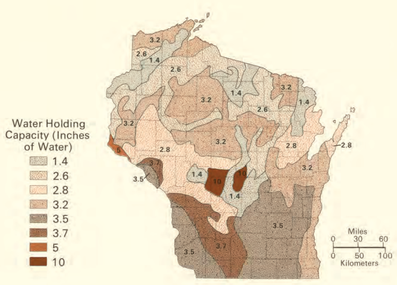
Map 3. LAND-SURFACE FORMS (after the National Atlas)

The flattest area is in Central Wisconsin (1). Undulating plains, with little wetland (2) and with considerable wetland (3) are mostly in the north. Irregular plains, with little wetland (4) and with considerable wetland (5) occupy much of the state. Plains with high hills (6) are in Iron and Ashland Counties. A tableland with escarpment to Lake Superior (7) is in the northwest. Open hills, with broad ridges (8), and narrow ridges with deeply incised valleys (coulees) (9) are in the southwest.



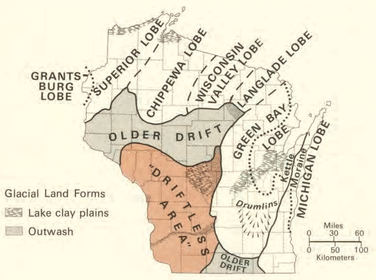
Map 4. AVERAGE PRECIPITATION (April to September, inclusive)

The April to September rainfall is 23 to 24 inches in the far northern highland and at the southwestern corner of the state; and 18 to 21 inches in east central Wisconsin. Of the 31 inches of annual precipitation, 68 percent falls during these six months when plants are growing. The rainiest month is June; the driest, December. Soils are commonly saturated in April when the snow and ice melt. Soils are commonly driest during August through autumn.



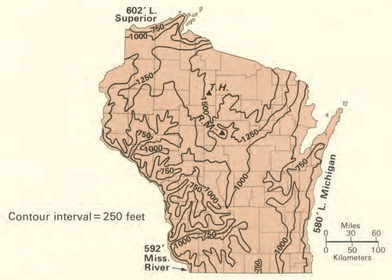
Map 5. ESTIMATED MAXIMUM WATER-HOLDING CAPACITY (inches of water in 2 ft. [60 cm] of soil)

The silt loams and associated silty clay loams have the notable capacity to hold water that is available to plants: 3.0 to 3.7 inches (7-9 cm) in the first 2 feet of soil. Loams are intermediate (2.6-2.8 in; 6-7 cm). Sands are the most droughty (1.4 in; 3.5 cm). Mucks and peats hold enormous amounts of water (at least 10 in.; or 25 cm). During most of the growing season, upland and artificially drained lowland soils are depleted of water to some extent, as plants transpire.



Map 6. GLACIAL GEOLOGY

The last major advance of the ice sheet over Wisconsin was about 16,000 years ago. It covered all but the "driftless" and "older drift" areas. A later ice advanced about 11,000 years ago (dotted boundaries), burying a forest in Manitowoc County. Many land forms were created by the glacial ice and meltwaters: Moraines (solid lines), elongated hills called drumlins, outwash, and lake clay plains. Many peat bogs and lakes occupy glacial pits called kettles.

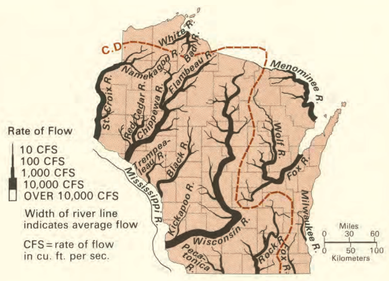


Map 7. LAND SURFACE (Elevations in Feet)

The rise from the surface of Lake Michigan to the top of Tim's Hill (TH) (1,953 ft; 595 m) on a glacial moraine in Price County is 1,373 ft (419 m), which is 81 ft (16 m) less than the height of the Sears Building (1,454 ft; 443 m) in Chicago. The top of Rib Mountain (RM) (1,941 ft; 591 m), near Wausau, stands 780 ft (237 m) above the nearby Wisconsin River. On a national scale, Wisconsin is considered to be a plain (see Land Surface map).

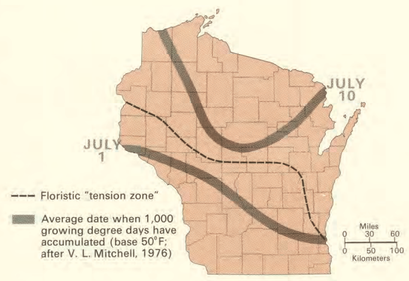
Map 8. GEOGRAPHIC PROVINCES (after Martin, 1932)

The Lake Superior Lowland is an old glacial lake bottom sitting in a much older depression in the bedrock surface. The Northern Highland is a glacial-drift-covered Precambrian "dome," a southern extension of the "Canadian Shield" of igneous and metamorphic rocks. The Central Plain is on an arc of Cambrian sandstones. The drift-covered Eastern Ridges and Lowlands are crossed by dolomite escarpments. The Western Upland is dissected by numerous tributaries to the Mississippi and Wisconsin Rivers.



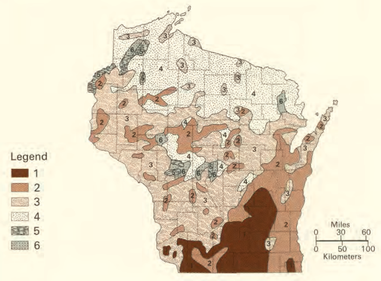
Map 9. PRINCIPAL RIVERS AND THEIR AVERAGE FLOW

Thirty percent of the state drains to the St. Lawrence River basin, and the remaining 70 percent to the Mississippi River basin. The dashed line represents the continental divide (C.D.) between these two major basins. Peak flows are in March, April and June. The Wisconsin River drains 21 percent of the area of the state; the Chippewa-Flambeau system drains 17 percent; the Fox-Wolf system in northeastern Wisconsin drains 12 percent of the state.



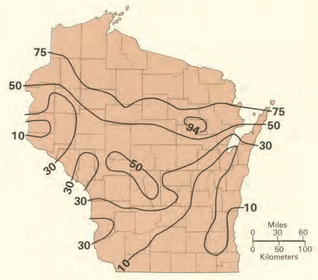
Map 10. CLIMATIC ZONATION IN WISCONSIN

The difference in early growing season temperature between northern and southern Wisconsin is shown by the July 1-10 lapse time required for the same amount of solar heat to accumulate in the north as in the south. The floristic "tension zone" separates northern pine country from southern prairie-oak forest country.



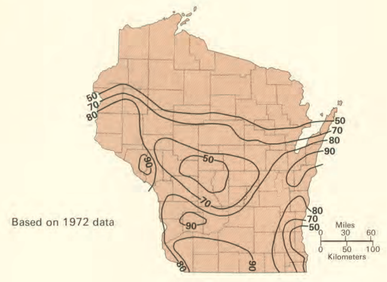
Map 11. AGRICULTURAL AND FORESTRY LAND USE

The map shows land use in terms of proportions of land devoted to agriculture and forestry. Highly productive farm land (1), with less than 15 percent of woodland, is in southern counties. Productive farm land (2), with the same extent of woodland, is prominent in the east, but is also widely scattered. Agricultural land with 15 to 50 percent in woodland (3), occupies about half of the area of the state. Forest lands, not sandy (4), are prominent in the north. Jack pine (5), and scrub oak (6) sandy lands are concentrated in the central plain and northern counties.



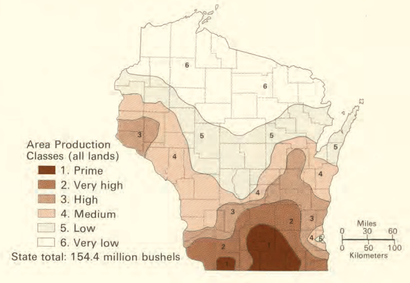
Map 12. PERCENT OF LAND IN FOREST OF COMMERCIAL VALUE

Forests and woodlands of Wisconsin occupy about 40 percent of its area, 99 percent of which are capable of producing wood for commercial purposes. Pulpwood is produced in greater volume than lumber and veneer. There are two national forests, two state forests, 27 county forests and numerous town, school, and private forests. Sixty-one percent of Wisconsin's forests are in the north.



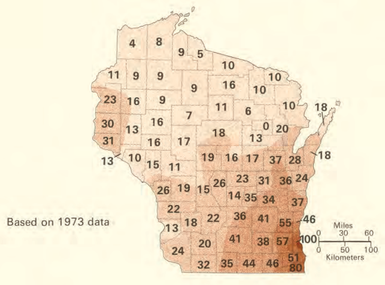
Map 13. PERCENT OF LAND IN FARMS (1972)

Half of the area of the state is in farms. Most of the farmland is in the southern two-thirds of the state. The west central plain and urban counties have fewer farm acres. Forests, parks, and wildlife areas are extensive in the north.



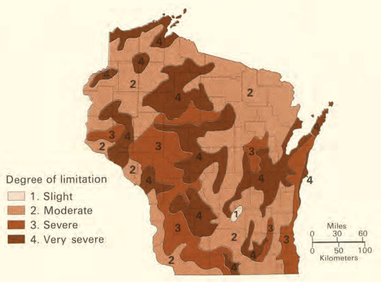
Map 14. CORN FOR GRAIN PRODUCTION (based on millions of bushels per county, 1975)

Nearly two-and-a-half-million acres of corn for grain and one million acres of corn for silage were harvested in Wisconsin in 1975. This crop demands less lime than alfalfa, and so is not as closely associated with the state's "limestone belt." The development of short-season corn varieties has made cultivation of this crop possible in many northern counties.



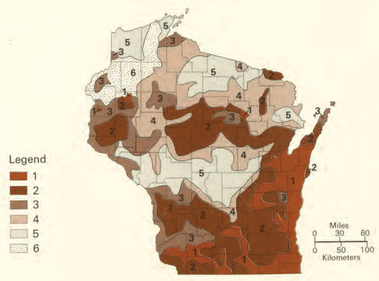
Map 15. RURAL LAND SALES INDEX (1973 base)

The rural land sales index is based on a scale of 100, with the rural land sale value in Milwaukee County as 100 (over $1,500 per acre in 1973) and that in the Menominee Indian Tribal Lands as 0. The index is highest near urban centers. Irrigation of sands in Adams County in recent years has apparently raised the index there above indices for Jackson and Juneau Counties. Northern counties show relatively low rural land sale indices. Indices for Oneida and Burnett Counties may reflect tourists' and retirees' interest in rural lands.



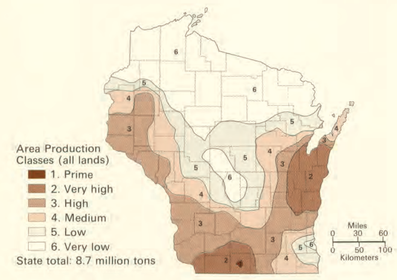
Map 16. SOIL LIMITATIONS FOR SEPTIC SYSTEMS

A successful septic system is designed to distribute sewage effluent through porous pipes laid in gravel beds set in natural soil. In at least 60 percent of the area of the state small scale septic systems commonly fail to work properly because the land is too steep, or soils are too wet, impervious or shallow to bedrock, with resulting contamination of surface and ground waters. There are various technical ways to improve the performance of septic systems. Some areas should simply not be used for waste disposal, because of danger of polluting wells and surface waters. This figure shows general problem areas.



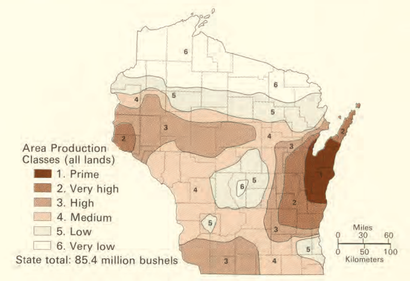
Map 17. SOIL RATINGS FOR AGRICULTURE

Using a soil ratings system with a range from 1 (best) to 10 (least productive), this map shows major soil areas by level of agricultural productivity. Prairie and some eastern red clay soils rate first, silt loams second, and some loams third. Sands in the north have agricultural productivity of only 6, on the average. Less productive soils are not shown because they are scattered in patches too small to be delineated. Acid, undrainable peat bogs and steep, rocky slopes are of little or no agricultural value.



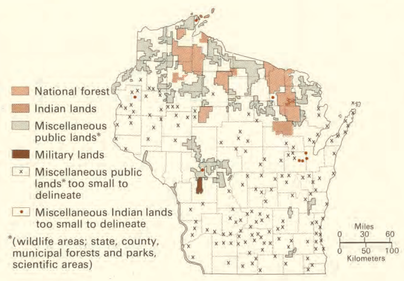
Map 18. ALFALFA HAY PRODUCTION (based on hundreds of thousands of tons per county, 1975)

In 1975, 3 million acres of alfalfa hay were harvested in Wisconsin. This high-protein forage crop is a mainstay of dairy agriculture. Because alfalfa uses much lime, the alfalfa "belt" coincides approximately with the limestone (dolomite) belt (see Bedrock Geology map). Extensions of the major alfalfa-producing area onto acid soils of north central Wisconsin were made possible by an agricultural lime and fertilizer program.



Map 19. OATS PRODUCTION (based on millions of bushels per county, 1975)

One and one-third million acres of oats were harvested in Wisconsin in 1975. This crop is important in producing feed and in serving as a nurse crop to alfalfa and other hay crops. Oats is a cool season grain, and so is well adapted to north central Wisconsin.



Map 20. MAJOR PUBLIC, INDIAN, AND MILITARY LANDS

Public lands are for the development of natural and wildlife resources and their appreciation by visitors. Indian lands are for the use and enjoyment of members of Indian tribes established in Wisconsin. Military lands are for military training. Some small parcels of land are designated as "scientific areas" for the preservation of choice landscape types that are threatened with extinction.

PHOTO-MOSAIC SOIL MAP OF WISCONSIN

WITH GENERAL SOIL TEST AND GEOGRAPHIC INFORMATION

Francis D. Hole

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COOPERATIVE EXTENSION PROGRAMS UWEX

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March 1977

$1.50

A2822-1 PHOTO-MOSAIC SOIL MAP OF WISCONSIN

THE PHOTO-MOSAIC SOIL MAP OF WISCONSIN

The photo-mosaic soil map (Plate I) is a composite of a photographic image and a soil map of Wisconsin.

The photographic image shows major natural and cultural features. Darkest areas are (1) lakes and flowages, (2) wetland (as in western Adams County), and (3) forested uplands (the northern counties, western Clark County and Menominee Tribal Lands). The dendritic pattern of valleys in southwestern Wisconsin is shown boldly by dark bands of woodland on steep slopes. Gray areas are cultivated lands. These are extensive in the Lake Superior Lowland, in southwestern Wisconsin on ridge crests and in valley bottoms, and in many southeastern and north central areas. The pale grid pattern of roads is notable in the two areas just mentioned. Nearly white areas are cities, of which Milwaukee is the most prominent. There are some light clouds on the north shore of Green Bay and over parts of Iron, Price, and Lincoln Counties.

The distribution of 26 major soil landscapes is indicated by boundaries and numerical symbols. These are explained in the lower left corner of Plate I, in terms of soil texture (silt loam, silty clay loam, loam, loamy sand, sand, peat, and muck), general character of the landscape, and approximate location. This information is generalized from the color wall map of Soils in Wisconsin (Hole, 1976)[1], the map symbols of which are given in the last column of Table 1, along with principal soil series names.

The photo-mosaic soil map does not show bedrock patterns, soil test values, relative land values, and some other soil-related landscape properties. The accompanying small state maps shown above give some of this information, presented in forms adapted from a variety of published sources.

The pattern of distribution of solar energy over the state is not well enough known to present a map of it. We do know that the land area of Wisconsin receives annually about 175 quintrillion calories (1.75×10^{20}) from the sun. This is equivalent to the fuel energy stored in 58 trillion tons of bituminous coal. Without this solar energy, food production, circulation of wind and water, and life itself would cease.

[1] Hole, F. D., 1976, *Soils of Wisconsin*, Bul. 87, Soil Series 62, Wisconsin Geological and Natural History Survey. This publication may be obtained from the University of Wisconsin Press, Box 1379, Madison, WI 53701. Other maps and reports on natural resources of Wisconsin may be obtained from the Geological and Natural History Survey, University of Wisconsin–Extension, 1815 University Ave., Madison, WI 53706.

SOIL TESTS

The table presents a summary of results of several soil tests for cropped and fertilized fields. Estimates are given for fields in each of the 26 soil associations of the photo-mosaic soil map on the other side of this sheet. (Tests on unfertilized soils usually show half or less than half the amounts of available phosphorus and potassium given in the table.)

Highest levels of organic matter are in mucks (map unit 26), in naturally wet mineral soils that have been drained for cropping (unit 25), alluvial soils (unit 24), upland clays (units 22, 23) and upland prairie soils (units 6, 15). Dry sandy soils show lowest contents of organic matter (units 10, 11). Average values are given in the fifth column of the table. The three preceding columns indicate the distribution of soil tests in the categories of low to high contents of organic matter. A high content of organic matter in the soil is a desirable property for good tilth and improved capacity to hold water and available plant nutrients.

Content of available phosphorus is high in intensively cropped sands and sandy loams (units 20, 21), potato and truck crop soils (units 17, 26) and alluvial soils (unit 24). Contents are low in red clays (units 22, 23). Phosphorus tends to become fixed and available to plants with difficulty, particularly in clays. A minimum of 60 pounds per acre of phosphorus should be available to plants.

Highest levels of available potassium are in prairie and lowlands soils that have been well fertilized (units 1, 5, 25) and alluvial soils (unit 24). Mucks (unit 25) are heavily fertilized for truck crops. Lowest levels are in sands and sandy loams (units 10, 11, 21). A minimum of 200 pounds per acre of potassium should be available to plants.

Soil reaction (pH) is highest (least acid) on red clays, lowland soils, and alluvial soils (units 22, 24, 25), and lowest (most acid) in sands and potato soils (units 10, 11, 17, 20, 21). Because of the scab disease potato soils are usually kept at pH 5.5 or below, except where scab-resistant varieties are grown, allowing a pH as high as 6.0. For most other crops, a pH of 6.5 to 7.0 is desirable. Some typical lime requirements are indicated. Wisconsin is fortunate to have an abundance of limestone, particularly dolomite, suitable for grinding to "ag lime" for use on fields. The dairy industry provides large amounts of manure that are usually spread back on the soils early in the growing season.

Table 1. Soil test data for plow layers of representative soils of Wisconsin.[1]

	Organic matter %				Available phosphorus lbs/A				Available potassium lbs/A				Soil reaction pH				Lime req. T/A	Representative corresponding soil names and symbols from Soils of Wisconsin color map, 1:710,000 (Hole, 1976)[2]
	Low 0-2	Med 2-5	High >5	Av.	Low 0-50	Med 51-100	High 101-200+	Av.	Low 0-200	Med 201-400	High 400+	Av.	Low 4.5-6.5	Med 6.5-7.5	High 7.5+	Av.	Av.	
	% of soil tests				% of soil tests				% of soil tests				% of soil tests					
1	0	96	4	3.7	55	31	14	60	44	48	8	229	30	69	1	6.6	0.79	Tama, Richwood (A1, 11)
2	0	90	10	3.9	59	28	13	55	40	52	8	239	31	68	1	6.6	0.87	Dodgeville, Tell (A2, 14)
3	35	65	0	2.2	65	25	10	51	70	27	3	175	34	65	1	6.6	0.36	Fayette, Seaton (A5-8, 12)
4	28	71	1	2.3	68	21	11	50	69	28	3	183	37	62	1	6.8	0.36	Dubuque, Palsgrove (A3, 4, 6, 9, 10, 13)
5	4	87	9	3.8	45	45	10	71	49	45	6	222	27	71	2	6.6	0.72	Plano, Ringwood (B5, 21-22, 32)
6	0	75	25	4.5	62	26	12	53	43	54	3	224	55	45	0	6.4	1.55	Varna, Elliott, Ashkum (B20)
7	35	65	0	2.2	44	37	19	70	63	35	2	138	29	69	2	6.7	0.28	Lapeer, Miami, Fox (B1, 3, 6-8, 10-18, 23-31, 33, 34)
8	20	79	1	2.4	63	27	10	52	61	37	2	188	54	45	1	6.4	1.16	Morley, Blount (B9, 19)
9	50	45	5	2.7	34	39	27	87	63	34	3	184	44	55	1	6.4	0.55	Casco, Rodman, Hochheim (B2, 4, 12)
10	94	6	0	1.5	24	33	43	102	76	23	1	146	60	39	1	6.2	0.38	Sparta, Dakota (C5, 8, 9, 16)
11	87	10	3	1.5	16	39	45	107	84	16	0	136	69	31	0	6.0	0.53	Plainfield, Nekoosa, Boone, (C1-7, 10-18)
12	42	55	3	1.7	48	31	21	56	73	24	3	156	53	46	1	6.8	1.05	Norden, Hixton, Gale (D1-7, 9, 10)
13	52	46	2	1.8	33	38	29	87	76	21	3	162	57	43	0	6.3	0.92	Elm Lake, Merrillan, Kert (D8, 11-13)
14	6	80	14	3.7	58	25	17	57	73	22	5	175	15	60	25	6.9	0.80	Emmet, Onaway, Longrie, Shawano (E1-13)
15	2	90	8	4.1	50	25	25	65	70	29	1	118	53	46	1	6.2	0.55	Jewett, Pillot (F8)
16	3	84	13	3.8	65	20	15	54	67	29	4	176	54	45	1	6.3	2.08	Santiago, Freer, Norrie (F1-7)
17	28	72	0	3.8	28	26	46	113	56	36	8	201	61	39	0	6.2	0.92	Antigo, Fenwood, Stambaugh (F10-17, 24, 25)
18	16	82	2	2.9	55	31	14	59	81	18	1	145	59	41	0	6.2	1.70	Spencer, Almena, Poskin (F21, 22, 26)
19	3	95	2	3.2	64	26	10	52	70	28	2	163	59	46	1	6.3	2.50	Clifford, Withee, Dolph (F9, 18-20, 23)
20	68	32	0	1.7	35	18	47	114	63	28	9	149	46	46	8	6.0	1.52	Iron River, Milaca, Kennan, Pence (G1-28)
21	33	55	12	2.9	29	8	63	138	76	23	1	170	81	19	0	5.5	1.94	Vilas, Omega, Pence (H1-7)
22	2	81	17	4.0	73	19	8	39	67	30	3	184	1	70	29	7.3	0.04	Kewaunee, Hortonville, Oshkosh (I3-6, 10-17, 20, 21)
23	9	83	8	3.6	96	3	1	19	59	40	1	190	67	33	0	6.3	2.09	Hibbing, Ontonagon, Superior (I1, 2, 7, 8, 18, 19, 22)
24	2	68	30	5.0	29	40	31	90	35	55	10	250	4	70	26	7.2	0.10	Arenzville, alluvial soils (J1, 2)
25	0	10	90	7.0	67	24	9	50	50	46	4	214	2	42	56	7.0	0.10	Newton, Pella, Navan (J3-11)
26	0	3	97	56.2	51	23	26	96	59	20	21	200	53	39	8	6.4	0.32	Peats and Mucks (J12-15)
State Total	22	73	5	2.9	50	30	20	67	70	27	3	175	40	55	5	6.5	0.94	All soils

[1] Wisconsin State Soil and Plant Analysis Laboratory, J. J. Genson, Director, 806 S. Park St., Madison, Wisconsin, 53706
Representative data were extracted from State and County summaries of soil test data for the period 1968-1973.

[2] Hole, F. D., 1976. Soils of Wisconsin. Bul. 87, Soil Series 62. University of Wisconsin Press.

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