

Issued May 25, 1916.

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE STATE OF INDIANA DEPARTMENT OF
GEOLOGY; EDWARD BARRETT, STATE GEOLOGIST.

SOIL SURVEY OF ELKHART COUNTY,
INDIANA.

BY

GROVE B. JONES, OF THE U. S. DEPARTMENT OF AGRICULTURE,
AND R. S. HESLER, OF THE INDIANA
DEPARTMENT OF GEOLOGY.

W. E. McLENDON, INSPECTOR, NORTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1914.]



WASHINGTON:
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1916.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., October 8, 1915.

SIR: During the field season of 1914 a soil survey was made of Elkhart County, Ind. This work was done in cooperation with the Indiana Department of Geology, and the selection of the area was made after conference with State officials.

I have the honor to transmit herewith the manuscript report and map covering this survey and to recommend their publication as advance sheets of Field Operations of the Bureau of Soils for 1914, as provided by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

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

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MAP.

Soil map, Elkhart County sheet, Indiana.

SOIL SURVEY OF ELKHART COUNTY, INDIANA.

By GROVE B. JONES, of the U. S. Department of Agriculture, and R. S. HESLER, of the Indiana Department of Geology.

DESCRIPTION OF THE AREA.

Elkhart County is situated in the northern part of Indiana, bordering the State of Michigan. It is bounded on the east by La Grange and Noble Counties, on the south by Kosciusko County, and on the west by Marshall and St. Joseph Counties. It is rectangular in shape and embraces an area of 462 square miles, or 295,680 acres.

The topography is characteristic of a glaciated region and varies from flat to hilly. The level land lies within a large outwash plain, one branch of which enters the county from the southeast and another from the south at a general elevation of 828 feet above sea level. These branches unite just north of New Paris and extend northwesterly, following in a general way the course of the Elkhart River, to the vicinity of Elkhart, where they spread out over the entire northern part of the county. The general slope of this plain is from the south to the north and west, there

being a difference in elevation of 79 feet between the points where it enters the county at the south and where it crosses the western boundary south of the St. Joseph River. In the western part of the county south of the outwash plain lies a large area of gently undulating country which extends to the southern boundary. On both sides of the nearly level plain areas and to the southeast the topography is rolling to hilly. The most marked elevations are the moraines north of Middlebury and between that point and Bristol. The uplands lie mainly between 800 and 900 feet above tide, though some exceed that height.¹

The entire county, with the exception of a portion of the southwest corner, is drained by the St. Joseph and Elkhart Rivers and



FIG. 1.—Sketch map showing location of the Elkhart County area, Indiana.

¹ Indiana Geological Reports, Vol. 25.

their tributaries. The St. Joseph crosses the northern part of the county. The Elkhart River, entering near the southeast corner, flows in a general northwesterly direction, uniting with the St. Joseph at Elkhart. The courses of these streams lie within the outwash plain, and practically no bottom land is found. In the sections of the county where the streams are small, especially in the gently undulating part to the southwest, drainage has been aided by large open ditches. Water power has been developed in many places along the larger and some of the smaller streams.

The first permanent settlers in Elkhart County came from Ohio, Pennsylvania, and the New England States about 1828. The county was organized in 1830, and, unlike many other counties, retains its original boundaries. At the time of organization the population was 935; in 1910 it was 49,008, about equally divided between town and country.

Goshen, the county seat, situated in the central part of the county, is a prosperous manufacturing town of 8,514 inhabitants in 1910. Elkhart, near the northwestern corner, is the largest town, with a population of 19,282. It is a manufacturing center, its chief products being automobiles, buggies, and band instruments. Other thriving towns are Nappanee, Wakarusa, New Paris, Bristol, Middlebury, and Millersburg.

With the exception of the northern part, where the roads are sandy and unimproved, the county is well supplied with gravel-surfaced roads. Roads of macadam and brick are being constructed from the principal towns. The transcontinental Lincoln Highway crosses the county.

Transportation facilities are good. The main line of the New York Central Railroad traverses the county in a southeasterly-northwesterly direction, passing through Goshen and Elkhart, at which points branch lines from the north and east join the main line, serving Middlebury, Bristol, and Vistula. The Louisville-Benton Harbor branch of the Cleveland, Cincinnati, Chicago & St. Louis Railway passes through New Paris, Goshen, and Elkhart. The Wabash Railroad crosses the southern part of the county from east to west and the Baltimore & Ohio Railroad traverses the extreme southwestern corner. Three electric lines also afford passenger and express service. The Chicago, South Bend & Northern Indiana Railroad connects Goshen and Elkhart with points in Michigan, and the Winona Interurban affords transportation from Goshen to Warsaw and other cities throughout central Indiana. The St. Joseph Valley Railroad (electric line) extends east from Elkhart through Bristol and Middlebury.

CLIMATE.

The climate of Elkhart County has the wide range in temperature characteristic of inland regions, the minimum being -22° and the maximum 103° F. The mean annual precipitation is a little over 35 inches, more or less equally distributed through the year. The average annual fall of snow is 60.5 inches, which affords adequate protection for winter wheat, rye, and clover seedings.

The following table, giving the normal monthly, seasonal, and annual temperature and precipitation and the occurrence of killing frosts, is compiled from records by the Weather Bureau station at South Bend. This station is in St. Joseph County, which borders Elkhart County on the west, and the table represents fairly accurately the conditions in Elkhart County. The station at Goshen was not established until the spring of 1914 and therefore has only short records.

Normal monthly, seasonal, and annual temperature and precipitation at South Bend, St. Joseph County.

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.	Snow, average depth.
	$^{\circ}$ F.	$^{\circ}$ F.	$^{\circ}$ F.	Inches.	Inches.	Inches.	Inches.
December.....	27.9	61	-15	2.98	8.25	4.92	13.4
January.....	25.2	66	-22	2.60	3.77	3.42	14.4
February.....	21.8	63	-20	2.21	0.82	0.42	13.9
Winter.....	25.0	66	-22	7.79	12.84	8.76	41.7
March.....	36.5	82	3	3.22	0.75	3.91	8.6
April.....	48.2	88	13	2.50	1.06	3.76	2.1
May.....	60.2	95	26	3.79	1.30	4.13	0.1
Spring.....	48.3	95	3	9.51	3.11	11.80	10.8
June.....	68.6	97	37	3.20	1.48	4.83	0.0
July.....	73.4	103	44	3.61	1.59	5.10	0.0
August.....	71.6	97	44	3.26	2.35	3.48	0.0
Summer.....	71.2	103	37	10.07	5.42	13.41	0.0
September.....	66.0	98	30	2.81	1.22	4.82	Trace.
October.....	53.3	95	12	2.29	1.49	2.43	0.9
November.....	39.5	74	7	2.80	3.84	2.36	7.1
Fall.....	52.9	98	7	7.90	6.55	9.61	8.0
Year.....	49.4	103	-22	35.27	27.92	43.58	60.5

Average date of first killing frost in fall, October 12; of last in spring, May 5. Earliest date of killing frost in fall, September 20; latest in spring, May 28.

AGRICULTURE.

Permanent settlement of Elkhart County, as already stated, began in the third decade of the nineteenth century. The fertile prairie lands along the Elkhart River in the present townships of Benton, Jackson, and Elkhart were the first chosen, as they required less labor to bring them under cultivation than the heavily timbered upland soils. Within a short time, however, small wooded patches were cleared and planted to corn and potatoes. In 1829 and 1833 the first gristmills were operated, at the mouth of Christian Creek and at Waterford. Fall wheat was grown, also corn, oats, potatoes, flax, and buckwheat. Only enough of the oat crop was thrashed to furnish seed for the next year's seeding, most of it being fed in the straw. Flax was important for many years, being used in the manufacture of homespun. Corn and wheat were often grown in the same fields year after year.

On the prairie soils the native grasses furnished an abundant supply of hay, but prior to the introduction of timothy, in 1835, farmers on the cleared areas were compelled to depend upon marsh hay for their stock feed. Redtop, which was introduced into the county in 1838, thrived in wet and shady places where timothy did not do well. Clover was first grown in 1845 on the soils of the Elkhart Prairie, and its acreage has increased rapidly since.

Apple orchards were first set out in the late thirties or early forties, and in 1860 fruit growing was started in the now noted fruit section southeast of Bristol.

Wheat was formerly the money crop of the county and was grown more extensively than any other grain. Within the last 20 years, however, the acreage has decreased, owing to diminished profits with the ravages of the Hessian fly. At present corn is the most important crop. As is the case with hay and oats, the greater part of it is fed to stock.

The following table, compiled from the census reports, giving the acreage of wheat and corn for the census years 1880, 1890, 1900, and 1910, is printed to show the drift of agriculture, so far as these staples are concerned, during this 30-year period:

Acreage of wheat and corn reported in Elkhart County, 1880, 1890, 1900, and 1910.

Year.	Wheat.	Corn.
	<i>Acres.</i>	<i>Acres.</i>
1880.....	50,716	30,589
1890.....	45,832	37,053
1900.....	51,901	41,950
1910.....	34,877	46,845

Oats are grown quite extensively on the upland soils, but the acreage on the sandy plain soils is small. In 1910 there were 21,349 acres devoted to oats, as against 10,585 acres in 1880. The acreage in rye, practically confined to the lighter textured soils of the county, is increasing.

Hay is an important crop in Elkhart County. It consists of timothy, clover, timothy and clover mixed, cowpeas, alfalfa, and marsh grass. In 1909, according to the census, there were 19,110 acres planted to timothy alone, 4,052 acres to clover alone, and 9,736 acres to timothy and clover mixed. These important grasses yielded a total of 41,659 tons of hay. Clover is usually seeded in the spring, with oats as a nurse crop.

Alfalfa is successfully grown on a number of soil types and the acreage is gradually increasing. Its importance as a feed and as a soil renovator is generally appreciated. Three cuttings, and sometimes four, are obtained each year, the yields ranging from 3 to 5 tons per acre.

Cowpeas are extensively grown, particularly in the northern part of the county. They seem to do well on the light sandy soils and furnish an abundance of feed for sections of the county where timothy and clover do not thrive. The crop is harvested about the middle of September. The green vines are sometimes used for ensilage. Cowpea seed sells for \$1.75 to \$3 a bushel. The New Era and Whippoorwill varieties are the most generally grown.

Rape is grown in a small way for hog and sheep pasturage.

A trucking industry of some importance has developed in parts of the county, especially near the larger markets. The sandy soils are well suited to the production of truck crops and there are some well-drained Muck patches used for the same purpose.

The growing of tomatoes for canning has assumed large proportions in the vicinity of Middlebury, where the only canning factory in the county is situated. From 5 to 8 tons per acre are generally obtained and the price, delivered at the factory, ranges from \$8 to \$10 per ton. Much of the crop is grown under contract. Some tomatoes are shipped to points outside the county.

In the vicinity of Nappanee cabbage is grown more extensively than elsewhere in the county. A sauerkraut factory has been established at this point. The usual price paid for cabbages is \$5 a ton.

Since 1860 the country south and southeast of Bristol has been favorably known as a fruit-growing section, and the industry has been established on a commercial scale for a number of years. The fruit produced is of excellent flavor and quality and as a rule the orchards are well cared for. Most of the orchard products are consumed locally. Small fruits, especially raspberries and blackberries,

are grown extensively throughout the northern half of the county and form the chief source of revenue for this section. The production of grapes has attained considerable proportions and is increasing.

For over 20 years the growing of celery at Goshen has been an important industry. Besides supplying the local markets, shipments are made to other points within the State. Three hundred dollars is the maximum amount received from an acre of this crop.

Peppermint and hemp, the other special crops, are grown principally in the southern part of the county on reclaimed marshlands.

The live stock which the pioneers brought into the county consisted of scrubs, though, as a rule, the cattle are said to have been of a better type than the hogs. The breeding of purebred stock was begun after 1850. Poland China, Duroc Jersey, and Ohio Improved Chester hogs are now popular breeds. Some Berkshires are also raised. Hog raising is an important industry in Elkhart County, being especially profitable when carried on in conjunction with dairying. According to the census, there were 25,991 hogs sold or slaughtered in the county during 1909.

Purebred or grade Shorthorn cattle were the first improved stock to be introduced. About 40 years ago Herefords were introduced, but did not become very popular. Ayrshire, Jersey, Durham, and Holstein cattle have been popular at different times. At present there are probably a larger number of Holsteins in the county than of any other pure breed. These are noted as milk givers and for the larger size of their calves.

On many farms dairying is carried on with profit as an adjunct to general farming. The average farmer keeps 6 to 10 milch cows, although some have a larger number and make dairying a specialty. The silo is in general use and a large acreage is devoted to corn for ensilage. Several creameries are in operation. A condensed-milk factory at Goshen affords a ready market for the surrounding territory. The milk produced is more than enough to supply the local demand and some is shipped to outside points.

In 1899 the dairy products of the county, excluding those devoted to home use, were valued at \$174,819, while 10 years later their value had increased to \$407,772. Conditions in the county are very favorable for the development of dairying, and this branch of farming is increasing in favor.

Sheep were brought into the county by some of the earliest settlers. Merinos were the first purebred sheep to be raised, but these have been supplanted by the mutton breeds, including Shropshire, Oxford, and Southdown. The census gives the number of sheep and goats sold or slaughtered in 1909 as 15,764.

The use of stable manure is general and a liberal quantity is usually applied to the plowed land in the fall. Manure spreaders are commonly used. The use of commercial fertilizer is confined mainly to the upland soils and to those farms on which there is not sufficient barnyard manure. The sandy soils are improved by growing such legumes as cowpeas and soy beans, as farmers on these types do not as a rule keep much stock.

Rotation of crops is practiced by the majority of the farmers. The rotation most commonly followed consists of wheat, clover, and timothy one or two years, followed by oats and then by wheat. Where dairying is carried on the usual rotation is corn two years, followed by oats, and then by one or two years of clover.

The farm buildings are generally large, substantial, and well kept, having the latest improvements and conveniences and giving evidence of thrift and prosperity. Farm machinery of the latest designs, including corn planters, shredders, wheat drills, and harvesters, disk plows, manure spreaders, rollers, and ditching machines, is found upon the farms.

Labor is scarce. Monthly wages range from \$20 to \$30, with board, while harvest hands and extra help receive \$2 to \$2.50 per day.

As compared with many sections of the country, there is little tenant farming in this county. The census of 1910 shows that 71.6 per cent of the farms are operated by the owners. Farms are generally rented on a share rather than on a cash basis, the owner furnishing the seed and getting one-half the products, the tenant to deliver the owner's share.

The average size of farms is 84.9 acres. Ninety-one per cent of the land area of the county is in farms and of this 84.2 per cent is classed as improved. In 1910 the average value of farm land was \$66.58 an acre.

The question of drainage is an important one for the farmers of Elkhart County. A more effective drainage system could be profitably installed on some of the soil types. There are many marshes and areas of wet land that can be reclaimed by artificial drainage.

SOILS.

The soil materials of Elkhart County are mainly of foreign origin and the soils show no close relationship to the underlying rocks. They are all derived from glacial material in a more or less modified form and fall into two main groups, soils of the upland and soils of the sand plains. The latter, which represent glacial outwash, cover the northern part of the county, with coalescing areas extending south. This glacial drift varies in thickness. At Elkhart it is known

to be 125 feet thick, at Goshen 162 feet, and at New Paris 90 feet.¹ Well borings at Elkhart show the first 25 feet to be of sand and gravel, underlain by indurated glacial clay, with occasional thin strata of quicksand: The upland, occupied by soils locally known as "clay soils," varies in topography from undulating to hilly and is composed of an unassorted mass of sand, gravel, clay, and bowlders, with a more homogeneous surface covering. The rough morainic areas are chiefly confined to the eastern part of the county, where the highest elevations are attained. Another feature of the topography peculiar to glaciated country is the kettle holes and the areas of Muck and Peat marking the beds of former lakes.

Excluding the miscellaneous types, Muck, Peat, and Meadow, 11 soil types are mapped in this county, and these are grouped into four series. All of these soils were originally derived from glacial material, but varying conditions and forces have developed distinguishing characteristics in each.

In the Miami series, consisting of light-colored upland soils, four types of varying texture are mapped. Two members of the Clyde series are found, occupying depressions and old glacial-lake beds. The Plainfield series, embracing the light-colored soils of the outwash plains and terraces, is represented by four types. The Waukesha series, represented by one member, is found as a prairie soil associated with the soils of the outwash plain.

The following table gives the names and extent of the several soil types mapped in Elkhart County:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Miami loam.....	109,504	37.0	Waukesha sandy loam.....	6,016	2.0
Plainfield sandy loam.....	79,872	27.0	Clyde loam.....	5,952	2.0
Miami sandy loam.....	36,800	12.5	Plainfield sand.....	4,800	1.6
Muck.....	12,288	4.2	Plainfield gravelly sandy loam.	4,160	1.4
Plainfield loamy sand.....	11,264	3.8	Miami clay loam.....	3,392	1.2
Clyde sandy loam.....	7,616	2.6	Peat.....	320	.1
Miami gravelly sandy loam.....	7,168	2.4			
Meadow.....	6,528	2.2	Total.....	295,680	

MIAMI SERIES.

The Miami soils are brown, light brown or grayish, and are underlain by yellowish and brown, heavier textured subsoils. Mottlings of brown and light gray are present in the subsoils in many places, particularly in the case of the heavier members of the series.

The surface drainage is usually good, but artificial drainage is necessary in some of the heavier types. The soils are derived through weathering from glacial till of a generally calcareous nature.

MIAMI SANDY LOAM.

The surface soil of the Miami sandy loam to an average depth of 10 inches consists of a brown, medium to fine textured sandy loam. There are usually present on the surface and mixed with the soil varying quantities of gravel, large pebbles, and small bowlders. In some places, notably northeast of Goshen, occasional small spots of Miami sand are found associated with this type, usually occupying the tops of the hills and ridges. These areas were too small to map separately. The subsoil consists of a light-brown to yellowish, light-textured sandy loam, grading into a sticky sandy loam or loam at an average depth of 20 inches. Near the Miami loam areas the surface soil of the Miami sandy loam becomes heavier and the texture is inclined to be fine. In such locations the subsoil generally becomes heavier with depth, grading into a heavy loam or clay loam in which the sand and gravel content is low. In the rougher areas beds of gravel are found underlying gravelly clay at depths ranging from 4 to 10 feet beneath the surface.

In extent and agricultural importance the Miami sandy loam ranks second among the soils of the uplands. The largest areas of the type occur in the eastern and central parts, east of the outwash plain. Another good-sized area occurs as a narrow, unbroken strip bordering the western edge of the outwash plain. This area broadens southwest of Goshen and embraces the high and rolling country north of Foraker.

The topography ranges from gently rolling to rolling and hilly and the soil is thoroughly drained. The steeper land is excessively drained, and on such land, as well as on that of sandier texture, crops suffer during long droughts.

Approximately all of the Miami sandy loam is under cultivation. Small uncleared areas, supporting a growth of maple, oak, hickory, and beech, with elm and walnut, remain. General farming is the prevailing type of agriculture.

The Miami sandy loam is a good soil for corn, oats, wheat, clover, alfalfa, and buckwheat. Farmers estimate ordinary yields of corn as 30 to 50 bushels; of wheat, 12 to 25 bushels, usually about 17; and of oats, 25 to 50 bushels, usually about 35 bushels. Hay cuts three-fourths ton to 1½ tons per acre. Potatoes of very good quality for fall and winter use are grown for local markets as well as for home consumption, and the ordinary yield is about 100 bushels to the acre. In wet seasons the yields are better on this type than on the heavier soils and the quality of the tubers is superior.

Apples, peaches, pears, grapes, and small fruits are successfully grown, but orcharding and viticulture are not engaged in on a large scale. Trucking is specialized in to a small extent.

The Miami sandy loam is easily cultivated and requires less labor to work up a pulverulent seed bed than the other upland soils. While the usual yields are slightly under those obtained on the heavier types, the better tracts of this soil command practically the same price.

No commercial fertilizers are used, and the supply of barnyard manure is in many cases insufficient. The application of barnyard and green manures is particularly advisable.

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

Mechanical analyses of Miami sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
281909.....	Soil.....	4.1	15.4	24.9	28.8	5.6	16.3	5.1
281910.....	Subsoil.....	3.6	13.6	16.0	25.0	11.2	19.7	10.7

MIAMI GRAVELLY SANDY LOAM.

The Miami gravelly sandy loam consists of a light-brown, medium sandy loam to loam, 8 to 10 inches deep, underlain by a yellowish or reddish-brown gravelly sandy loam, often containing enough clay to make the soil particles cohere. Gravel, stones, and bowlders occur on the surface and mixed with the soil, most abundantly on the crests of hills and ridges. The gravel content, as a rule, increases in quantity with depth, and frequently a layer of gravel is encountered at 30 to 36 inches.

Areas of the Miami gravelly sandy loam are confined to the north-eastern part of the county, largely in the vicinity of Middlebury. The isolated area southeast of Bristol is much sandier than the typical soil, and in places is a gravelly sand. The same is true of that portion of the large area north of Middlebury which borders the outwash plain. Small areas of Miami stony loam are included within the type as mapped.

The Miami gravelly sandy loam has a rolling, hilly, and in places hummocky topography. It occupies the highest elevations and roughest positions in the county. On account of the irregular surface and the underlying gravel, the natural drainage is good. On the more elevated positions drainage is excessive and the soil often suffers from drought. The steeper slopes are subject to erosion, though it is severe in only a few places.

The Miami gravelly sandy loam is devoted to general farming and orcharding. Not over 5 per cent of this land is too uneven for cultivation, and such tracts are used for pastures. Corn, wheat, oats, clover, and alfalfa are the principal crops. The ordinary yield of corn is 35 bushels per acre, of wheat 10 to 20 bushels, and of oats 20 to 35 bushels. Some rye is grown, the yields averaging 15 to 25 bushels per acre. Clover and alfalfa do especially well. Both are usually seeded with a nurse crop. Clover hay yields $1\frac{1}{2}$ to 2 tons per acre, and alfalfa 3 to 5 tons.¹

The area of Miami gravelly sandy loam located southeast of Bristol is devoted almost entirely to trucking and fruit growing. On account of its higher sand content and thorough drainage, it is a good early truck soil. All the vegetables favored by the climate are successfully produced. Cantaloupes and watermelons, strawberries, raspberries, blackberries, plums, peaches, apples, pears, cherries, and grapes are extensively grown, and fruit of very fine quality and flavor is produced. Most of the fruits and vegetables are sold to local markets, but some are shipped to outside points.

Barnyard manure is almost invariably used where general farming is practiced. When this is used in conjunction with green manures, such as cowpeas, soy beans, and clover, the productiveness of the soil is much more easily increased and maintained. Fruit growers and truckers generally use commercial fertilizers in addition to stable manure, and some use cottonseed meal with success.

Land of the Miami gravelly sandy loam ranges in price from \$65 to \$100 an acre. Orchard land in good condition has a higher value.

MIAMI LOAM.

The soil of the Miami loam, to a depth of about 12 inches, consists of a brown, mellow loam to heavy fine sandy loam, containing a rather high percentage of silt. When moist the soil has a decidedly brownish color, but on drying out it becomes light brown to grayish and in some cases whitish. A few glacial boulders and rock fragments, consisting of granite, quartz, greenstone, and syenite, are found scattered over the surface, but most of the larger stones have been removed from the cultivated fields.

The subsoil is a yellowish-brown clay loam containing varying quantities of coarse sand and fine gravel. This material frequently continues throughout the 3-foot section where the type occupies rolling or hilly topography, but generally at about 24 inches it gives way to a brown, heavy sandy clay or clay. This material, known as boulder clay, contains boulders and rock fragments and not infrequently beds of gravel at depths ranging from 10 to 25 feet below the surface.

¹ These figures represent averages as ascertained from estimates of farmers.

In the higher situations the soil nearly always contains a greater percentage of medium and fine sand than usual, and the subsoil more sand and gravel. Boulders and rock fragments are also more numerous. On the more level areas the soil has a higher silt content and the subsoil is more plastic and tenacious.

The Miami loam is the most important and extensive soil in Elkhart County. It is the main upland type. The largest and most typical areas occur in the southwestern and southeastern parts of the county.

The topography is gently undulating to rolling, and even hilly in the eastern part of the county. The roughest area occurs between Bristol and Middlebury, where the type is associated with the Miami gravelly sandy loam. In the vicinity of Wakarusa the surface is level to gently undulating. For the most part natural drainage is very good and artificial drainage is not necessary except in the flatter areas and draws, which have been greatly improved by tiling.

The original tree growth consisted of oak, hickory, maple, ash, beech, elm, and walnut.

The type is devoted to general farming, and all the ordinary crops are successful.

Farmers on this type give the ordinary yields of corn as 50 bushels per acre, of wheat 20 to 30 bushels, oats 20 to 60 bushels, and clover and timothy $1\frac{1}{2}$ tons of hay.

Cowpeas, rye, buckwheat, and millet are grown to a small extent. Alfalfa does well on this soil, but has not been sowed extensively.

Truck crops and fruit are grown for home consumption. Apples, peaches, pears, cherries, grapes, and small fruits do well.

Difficulty is frequently experienced in getting a good growth of clover and some farmers advise sowing it with oats in the spring rather than with wheat. Clover for seed gives 1 bushel to 2 bushels per acre.

A common rotation followed on the Miami loam consists of wheat, clover and timothy 1 or 2 years, then corn and oats, followed by wheat.

The Miami loam is a mellow, friable soil, and is easily tilled if plowed at the proper time. If plowed when too wet or too dry clods are formed which are difficult to pulverize. The soil is usually plowed to a depth of 8 inches and considerable fall plowing is done. Practically all of the type is under cultivation.

Commercial fertilizers are not used on this soil to any great extent, but the available stable manure is applied. The type is naturally deficient in organic matter.

Cowpeas grow readily, and besides furnishing a splendid hay help to increase and maintain the productiveness of the soil. Alfalfa

and clover also increase the nitrogen content of the soil through their ability to collect this important soil constituent from the air.

Recent land transfers show that the Miami loam commands \$85 to \$100 an acre without buildings and from \$100 to \$125 an acre with improvements.

In the following table the results of mechanical analyses of samples of the soil and subsoil of the Miami loam are given:

Mechanical analyses of Miami loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
281905.....	Soil.....	2.2	5.8	9.8	19.2	13.0	36.9	13.0
281906.....	Subsoil.....	1.4	4.8	8.2	16.6	12.6	40.8	15.7

MIAMI CLAY LOAM.

The Miami clay loam consists of a light-brown to grayish silty loam to clay loam, 6 to 8 inches deep, underlain by a mottled yellow and gray, compact silty clay. Very little stone or gravel occurs in the soil or on the surface and the subsoil is practically free from coarse material.

Most of this soil, which is of small extent, is included in two areas, the larger at Jonesville in Harrison Township and the other in Olive Township along the county line. Four small areas occur along small drainage ways in this section of the county.

The topography of the Miami clay loam is nearly level, and the natural drainage is poor. Tile drains are common, but the type as a whole would be greatly improved by more complete systems of underdrainage.

Practically all of this type is used for agriculture, a few woodlots being the exception. It is devoted mainly to general farming. The crop yields are usually slightly below those obtained on the Miami loam. Timothy and clover, separate or mixed, do very well. Alfalfa is successfully grown, but the acreage at present is small. Of the grain crops wheat and oats do best. Under intelligent methods of cultivation corn gives good yields.

The Miami clay loam is deficient in organic matter and even greater care must be exercised in its cultivation than is the case with the loam. Cultivating it when wet causes clodding and baking, and cultivating when too dry causes large clods to form. By judicious handling, however, a mellow seed bed can be obtained. The soil is greatly benefited by turning under leguminous crops. No commercial fertilizers are used at present.

The value of land of this type averages about \$100 an acre.

CLYDE SERIES.

The Clyde series comprises dark-brown to black surface soils, with gray, drab, or mottled gray and yellowish subsoils. These soils are derived through deposition or reworking of the soil material in glacial lakes or ponds, the dark color of the surface soils being due to the high percentage of organic matter caused by the decay of plants under swampy conditions. The soils of the Clyde series grade into Muck and Peat on the one hand and into the lighter and better drained glacial-lake soils on the other, with rather sharp boundary lines. The topography is level and the soils are naturally poorly drained. The series in this county comprises two types, the Clyde sandy loam and loam.

CLYDE SANDY LOAM.

The Clyde sandy loam consists of 10 to 15 inches of grayish-black to black material, varying in texture from a sandy loam to sand or loamy sand, underlain to a depth of 36 inches or more by a drab, gray, or yellowish sandy loam or slightly sticky sand. The subsoil contains some calcareous material, and small gravel occurs in both the soil and subsoil. The relatively high content of organic matter gives the soil its dark color and loamy texture and renders it easy to cultivate.

This type occurs in the outwash plain and occupies a physiographic position intermediate between Muck and the Plainfield sandy loam. The largest areas are found northeast and east of Elkhart. The topography is level and the drainage poor.

When reclaimed this is a fairly good corn soil, the ordinary yield being about 50 bushels per acre. Small fruits and vegetables are profitably grown. A large percentage of the type is used for pasture. It is for the most part treeless, although in places willow and other hardwoods are found.

The price of this land ranges from \$75 to \$125 or more an acre, depending upon drainage conditions.

The results of mechanical analyses of samples of the soil and subsoil of the Clyde sandy loam are given in the following table:

Mechanical analyses of Clyde sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
281921.....	Soil.....	2.2	17.6	27.2	21.2	4.5	18.7	8.7
281922.....	Subsoil.....	1.8	18.9	31.3	22.8	4.2	13.3	7.7

CLYDE LOAM.

The Clyde loam consists of a dark-gray to black heavy sandy loam to heavy loam, underlain at about 8 inches by a heavy bluish-drab clay loam or silty clay. In places the subsoil is dull brown or yellowish, and yellow and gray mottlings frequently occur.

In places the surface soil to a depth of a few inches consists of mucky material. Thin layers of fine sand frequently occur in the heavy subsoil, and it is not uncommon to find muck underlying the clayey subsoil, usually at a depth of 2 feet. Strata of muck, sand, and clay sometimes occur within the 3-foot section, but in no regular order.

The Clyde loam is most extensively developed in the southwestern part of the county. These areas are small, and for the most part occur as narrow strips along the smaller drainage ways, especially in the upper reaches. Other small tracts occur in glacial-lake beds and depressions. Because of the nearness to natural drainage outlets most of the type has been drained and placed under cultivation.

When well drained this soil produces good yields of corn, peppermint, potatoes, and cabbage, the average yield of corn being 75 bushels per acre. In acreage yields it is the leading corn soil of the county.

The natural growth consists of wild grasses, bushes, reeds, elm, and willow.

PLAINFIELD SERIES.

The surface soils of the Plainfield series range from brownish gray to brown, while the subsoils are usually yellow to yellowish brown in color, not heavier in texture than the soil, and rest upon beds of sand and gravel at shallow depths. The soils and subsoils are noncalcareous. This series comprises soils formed from sandy and gravelly glacial outwash and terrace material. The greater part of the material consists of sand and gravel from sandstone and shales or a mixture of material from these and other noncalcareous rocks. The topography varies from flat to gently undulating. The deposits are deep and the soils are well to excessively drained. Four members of this series are recognized in Elkhart County—the Plainfield sand, loamy sand, sandy loam, and gravelly sandy loam.

PLAINFIELD SAND.

The Plainfield sand consists of a light-brown medium to fine sand, extending to a depth of 6 to 8 inches, underlain by loose, incoherent yellow sand which becomes coarser with depth. In places the soil has drifted so badly that it is impossible to get a stand of any seeded crop. On account of the loose structure of this soil, it is easy to

cultivate and can be worked under a wide range of moisture conditions.

The Plainfield sand is confined to the northeastern corner of the county, where the larger of two areas occurs in a continuous strip north of the Little Elkhart River. This stream separates this main body from the smaller area near Bristol.

The type occurs as low ridges and knolls with intervening country having a nearly level topography. The elevations consist of loose sand, several feet deep, and have the appearance of sand dunes. They are materially influenced by the wind.

This soil is well to excessively drained. Its moisture-holding capacity is greatly increased through frequent shallow cultivations, and crops when properly handled suffer less from ordinary droughts than those on some of the heavier soils.

Cowpeas, corn, and rye are the principal crops grown. Only fair yields are obtained. This soil is too light for general farming. Cowpeas do best, and a considerable acreage is devoted to this crop. Six to ten bushels of seed per acre are usually obtained, selling for \$1.75 to \$2.50 a bushel. The vines are cured for hay and afford an excellent feed. Cowpeas also aid in maintaining the fertility of the soil, being especially valuable in localities where but little live stock is kept. Small fruits, peaches, apples, and vegetables do especially well in seasons of normal rainfall. The type is naturally deficient in organic matter.

The price of land of the Plainfield sand ranges from \$35 to \$50 an acre.

PLAINFIELD LOAMY SAND.

The Plainfield loamy sand consists of a light-brown, rather loose, loamy sand, 8 to 12 inches deep, grading into a yellow, incoherent sand of similar loamy texture. In structure and agricultural value this type is intermediate between the Plainfield sand and sandy loam. It is closely associated with these two types, occupying the broad outwash plain in the northern part of the county. The largest areas occur in the vicinity of Vistula. The surface of the larger areas is gently undulating, while the smaller isolated areas occur as low ridges, seldom over 3 feet above the surrounding sandy loam.

The drainage is good, but not so excessive as that of the Plainfield sand, consequently there is less leaching. The type is deficient in organic matter.

Early truck crops do better on this soil than general farm crops. Melons, cucumbers, tomatoes, and small fruits are grown successfully and a large acreage is devoted to these and other crops requiring a light-textured soil. A large proportion of the truck crops, as well as of the raspberries, blackberries, and strawberries, with which

the Elkhart markets are supplied, is produced on this soil. For these crops it is probably the best soil in the county. Peaches, apples, and plums do fairly well. Grapes are successfully grown. The growing of wormwood and tanzy for extracts is successfully conducted north-east of Elkhart.

For general farming the Plainfield loamy sand is a little too light, although fair yields are obtained with a normal amount of rainfall. Corn, hay, and cowpeas are the principal crops grown.

Land of this type ranges in value from \$50 to \$125 an acre, depending upon location.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Plainfield loamy sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
281919.....	Soil.....	0.0	6.2	28.0	49.4	3.4	9.5	3.5
281920.....	Subsoil.....	.0	5.2	26.0	52.2	4.0	9.1	3.6

PLAINFIELD SANDY LOAM.

The Plainfield sandy loam consists of a brownish or yellowish medium to fine sandy loam, 10 to 15 inches deep, underlain by a yellowish to somewhat reddish brown sticky sandy loam. At a depth of 24 inches the subsoil merges into a slightly coherent to loose sand and fine gravel, which extends to a depth of 36 inches or more. The soil contains a rather large percentage of fine gravel, and small cobblestones are common. The texture of the surface soil of this type varies greatly in different parts of the county, but the subsoil possesses greater uniformity. In the northwestern part of the county, and as far south as Dunlap, the soil contains a larger proportion of medium sand and fine gravel than in other sections, while south of Goshen it is composed of a more decidedly brownish compact sandy loam or light-textured loam.

The topography is level to gently undulating and drainage is thorough.

The Plainfield sandy loam is devoted largely to general farming, though considerable trucking is also carried on, especially in the vicinity of Elkhart, where the soil is more sandy and therefore better suited to such crops. On this lighter portion of the type cowpeas are extensively grown, but corn, rye, wheat, and potatoes are the main crops. The yields are usually 10 to 20 per cent lower than those obtained from the heavier soil. Strawberries, raspberries,

and blackberries yield well and are extensively grown. Grapes are very successful.

The heavier areas are devoted largely to the general farm crops. Corn, the leading crop, yields ordinarily about 50 bushels per acre, wheat 18 bushels, and rye 20 bushels. Barley is grown only to a small extent, but its acreage, as well as that of rye, is increasing. It yields about 30 bushels per acre. Oats do not give satisfactory results and very little is grown. Clover and alfalfa yield well, but timothy is not very satisfactory.

Commercial fertilizers are used only to a small extent, usually when the available stable manure is insufficient to meet the requirements.

Land values range from \$75 to \$150 an acre. Small tracts along the electric lines sell at a much higher figure.

In the following table the results of mechanical analyses of samples of the soil and subsoil of the Plainfield sandy loam are given:

Mechanical analyses of Plainfield sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
281911.....	Soil.....	5.9	26.2	21.4	25.4	3.5	11.9	5.8
281912.....	Subsoil.....	11.5	24.2	21.5	25.0	3.4	7.8	6.9

PLAINFIELD GRAVELLY SANDY LOAM.

The Plainfield gravelly sandy loam consists of a yellow or brownish gravelly sandy loam, 8 to 12 inches deep, underlain by a yellowish subsoil of the same texture. Both soil and subsoil contain a high percentage of fairly well rounded gravel, while cobblestones of varying size are numerous. In places the type resembles a stony loam, and often as much as 50 per cent of stone and gravel is found on the surface.

This type occurs along the St. Joseph and Little Elkhart Rivers, occupying terraces or second bottoms slightly below the other Plainfield soils. The largest areas occur on the north side of the St. Joseph River near Elkhart and Bristol. The surface of the type is level to gently undulating, and the areas are all well drained.

Fair yields of corn, oats, and hay are obtained, but the soil is rather too droughty for the general farm crops. It is an early soil and is best used for market-garden crops and fruits. Potatoes, strawberries, blackberries, raspberries, apples, pears, plums, peaches, and grapes are successfully grown.

WAUKESHA SERIES.

The soils of the Waukesha series are dark brown to black, and are underlain by yellowish-brown subsoils. The soils occur in prairies and are associated with the Plainfield soils in the areas of deep drift in the Central Lake States. Like the latter, they are derived from water-assorted glacial débris deposited in broad filled-in valleys or as outwash plains and terraces, and are sandy and gravelly in general character. They are more productive than the Plainfield soils, on account of their higher content of vegetable matter and greater moisture-holding capacity. The topography is level to gently undulating, and the soils are usually well drained. Only one member of the Waukesha series, the sandy loam, is mapped in Elkhart County.

WAUKESHA SANDY LOAM.

The Waukesha sandy loam consists of a dark-brown to black medium to fine sandy loam, 10 to 15 inches deep, underlain by a brown sandy loam in which a stratum of gravelly sandy loam is reached at about 2 feet. Beneath this a slightly sticky yellow sand to loose sand is found extending to a depth of 3 feet or more. The dark color of this type is caused by its relatively high percentage of organic matter. The surface soil is free from stone and gravel.

The largest area of this type occurs southeast of Goshen and is known locally as "Elkhart Prairie." It was upon this tract that the early development of the county was begun. There are also two areas near Elkhart and one at Bristol.

The type has a level topography and is the only true prairie soil in the county. Both surface drainage and underdrainage are well established. When plowed to the proper depth and cultivated frequently the soil conserves moisture well. It has been found advisable to break the ground to a depth of at least 8 inches. Owing to its thorough drainage, the soil warms up and matures crops earlier than the heavier upland soils.

The Waukesha sandy loam is more productive than any of the types located within the old outwash plain. It is devoted mainly to general farming, corn, oats, and wheat being the principal grains. Corn makes average yields of 40 bushels per acre, though 65 bushels are frequently obtained, oats 30 bushels, and wheat 18 to 20 bushels. Rye is not grown extensively. Clover makes an average yield of 1½ to 2 tons of hay per acre. Timothy does well and little difficulty is experienced in getting a good stand. Alfalfa succeeds and is gaining in favor, but the acreage devoted to it is still small. Fruits, vegetables, and truck crops are grown for home use and excellent results are obtained.

No definite system of crop rotation is used, although the following plan is used to some extent: First, corn; second, oats or wheat; third, clover or timothy. No commercial fertilizers and comparatively little barnyard manure are used. As a rule the land is given an application of manure before being planted to corn.

Farms on this type of soil are valued at \$150 to \$200 an acre. In a recent sale land southeast of Goshen brought \$165 an acre.

In the following table the results of mechanical analyses of samples of the soil and subsoil of the Waukesha sandy loam are given:

Mechanical analyses of Waukesha sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
281901.....	Soil.....	3.2	24.0	31.4	17.1	1.4	13.5	9.5
281902.....	Subsoil.....	3.0	22.1	32.7	24.2	2.1	6.4	9.2

MISCELLANEOUS MATERIAL.

MUCK.

Muck, or what is known locally as "marsh," consists of decayed and decaying vegetable matter mixed with mineral matter washed from the adjoining higher lands. It ranges in depth from a few inches in small areas and in narrow strips along streams to several feet in the large marshes.¹ There is usually considerably more mineral matter mixed with the material in the smaller areas, especially in the uplands, than in the large marshes, where much of the material is peaty.

The subsoil of the Muck occurring in the uplands consists of a thin layer of stiff blue to bluish-black clay, which in turn is underlain by grayish fine sand and in places gravel. The clay stratum is usually absent in those areas occurring within the outwash plain. Some of these are underlain by marl deposits. Peat, which is organic matter in a less advanced stage of decomposition, is frequently encountered below the surface stratum of Muck, and in places it appears at the surface.

Several good-sized areas of Muck occur in Elkhart County, the more important of which are east of Simonton Lake, east of Elkhart, northeast of Jonesville, east of Goshen, and east of Nappanee. These larger areas occupy flat depressions, being former lake beds, and the natural drainage is poor. Until recently the area east of

¹ Well borings in the area east of Goshen show the depth of the muck and peat deposits to be as much as 40 feet.

Simonton Lake contained Mud and Cooley Lakes, which were drained by means of large open ditches leading south. Practically none of this area is under cultivation, but large quantities of marsh grass are cut for hay. Marl deposits found throughout this marsh are used to a small extent as a fertilizer. The Goshen area has been planted almost exclusively to celery during the last 20 years, and the industry has been very profitable. However, the lack of a system of crop rotation, and possibly too generous applications of barnyard manure, have apparently caused a decrease in yields as well as an inferior quality of celery, especially within the last two years. Commercial fertilizers are used by very few of the celery growers at present, and only in small quantities, but their use is said to be profitable and is increasing. Commercial fertilizers containing a large percentage of potash are especially beneficial upon the Muck soil.

The large development of Muck east of Nappanee is devoted to the production of peppermint, onions, and hemp. Onions yield 400 to 500 bushels per acre, according to growers' reports, and sell for 28 to 50 cents a bushel.

While hemp has been grown but a short time and to a small extent, it has proved successful. The ordinary yields range from 3 to 4 tons per acre and \$12.50 per ton is received for the product delivered to the factory at Nappanee. In the adjoining county of Kosciusko a large acreage is used for hemp.

The growing of peppermint is confined almost exclusively to the southern half of the county, and a considerable quantity of the county's output is produced on Muck soil. The industry is considered a profitable one. The peppermint roots are planted in the early spring in rows 3 feet apart. The cost per acre of roots is \$10. Weeds are usually troublesome, and it is necessary to weed by hand after the plants attain a fair size. Mint is grown upon the same fields for a number of years in succession, but the ground finally becomes run down. Worn-out mint beds are frequently put in corn or potatoes for a year or two before replanting. Mint is cut in the same manner as grass, with a mowing machine. It is allowed to cure for several hours and is then hauled to the distilleries, of which there are a number in the mint-growing section. Two cuttings are sometimes made, but the second yield is light. Harvesting begins the latter part of July or the first of August and continues until October. Peppermint oil sells at \$1.50 to \$3.25 a pound. The oils runs 7 pounds to the gallon and the yield per acre is 25 to 50 pounds. Mint hay taken from the still and dried is relished by stock.

Truck crops are grown on some of the Muck areas near the larger markets.

Huckleberries grow wild in some of the marshes in the north-eastern part of the county and those placed on the market sell for \$1.25 to \$1.50 a bushel.

Many of the areas of Muck are treeless, supporting only a growth of reeds and wild grasses in the wetter portions. Others are heavily forested with elm, maple, willow, and some tamarack and low-growing bushes. A great many of the Muck areas remain unreclaimed.

PEAT.

Peat consists of coarse, fibrous, partially decomposed brown vegetable material extending to a depth of 3 feet or more. The material is quite highly combustible. It contains practically no mineral matter.

Only a few typical areas of Peat were mapped in Elkhart County, but where possible the type was separated from Muck. Many small patches were mapped with Muck and in places a mucky Peat, a gradation from one to the other, was classified as Muck.

The topography of the Peat areas is flat and the natural drainage poor. Some areas have been reclaimed and planted to the same crops as are grown upon Muck with approximately the same yields. The natural growth consists of wild grasses, weeds, huckleberry and other bushes, elm, willow, and maple.

MEADOW.

Meadow includes poorly drained, narrow strips of low-lying land along streams. The soil is quite variable in texture and subject to overflow. It consists for the most part of a dark-brown to black sandy loam to loam underlain by a heterogeneous mixture of sand, clay, and gravel. A mucky layer a few inches or more in thickness is not uncommon, and in places the mucky material is 3 feet or more in depth. Some areas along the Elkhart River in the vicinity of Benton, and others bordering Turkey Creek near New Paris, mapped as Meadow, are a brown, medium to fine sand or loamy sand.

The small areas of Meadow along the St. Joseph River are the result of backwater caused by the building of dams, and they, with the area at the junction of Turkey Creek and the Elkhart River, near Waterford, are the most poorly drained areas in the county, having no present agricultural value.

Along Turkey Creek and several of the other smaller streams that have been straightened and deepened a large acreage of Meadow has been reclaimed sufficiently to be used for pasturage.

With the exception of a few better drained spots which are usually planted to corn this soil is devoted to pasturage.

The forest growth consists of elm, oak, maple, sycamore, and willow.

SUMMARY.

Elkhart County is located in the northern part of Indiana, bordering the State of Michigan. It comprises an area of 462 square miles, or 295,680 acres. The surface consists of level plains and rolling to hilly uplands.

With the exception of the southwest corner, which is drained by tributaries of the Mississippi, the drainage of the entire county is carried into Lake Michigan by the St. Joseph River.

The first settlement was made in 1828, and the county was established in 1830. The pioneers came from Ohio, Pennsylvania, and some of the New England States. According to the census of 1910 the county had a population of 49,008. Elkhart, the largest city, with a population of 19,282, is about 100 miles from Chicago. Goshen is the county seat and has a population of 8,514. The population of the county is about equally divided between town and country.

The county is well provided with transportation facilities.

The mean annual rainfall is about 35 inches, the average annual snowfall is 60.5 inches, and the mean annual temperature is 49.4° F. The maximum range in temperature recorded is from 103° F. in July to -22° F. in January. The average date of the last killing frost in spring is May 5 and of the first in the fall October 12.

The type of agriculture followed in Elkhart County consists chiefly of general farming in conjunction with dairying. The greater part of the milk output is utilized by the urban population and by creameries and factories located within the county. Some milk is shipped to outside markets. Dairying is steadily increasing and the quality of the cattle gradually improving.

The principal crops are corn, hay, wheat, oats, and rye. A large percentage of the corn, oats, and hay is fed to live stock. Much of the corn is grown for ensilage, as the silo is in general use. Alfalfa grows successfully and the acreage is increasing. The light sandy soils in the northern tier of townships are devoted to truck crops, small fruits, and cowpeas. The region between Bristol and Middlebury is known as a fruit-producing section. Celery, peppermint, onions, and hemp are special crops grown on the more poorly drained soils.

The average size of farms is 84.9 acres. About 71.6 per cent of the farms are operated by the owners. The value of farm land ranges from about \$35 an acre for the most sandy land to \$125 an acre for heavier upland soils. Some of the prairie land, which is comparatively inextensive, has recently sold for \$165 an acre.

The soils of Elkhart County have all been formed from glacial drift material, which covers the entire county.

Exclusive of Muck, Peat, and Meadow, 11 soil types were mapped. These have been grouped in four series, of which two, the Miami and

Plainfield, cover almost seven-eighths of the county. The former occupies the uplands while the latter is found in the level to gently undulating outwash plain.

The Miami series is represented by 4 types. The Miami loam is the most extensive soil type in the county and is well adapted to general farming and stock raising. The sandy loam is a fair general-farming soil. The clay loam is the heaviest soil of the county, and is a good grass and grain soil. The gravelly sandy loam is of small extent, occupying rolling to hilly country in the northeastern part of the county. Portions of this type are profitably devoted to the growing of fruit. The Miami soils are light colored.

The Plainfield series is represented in this survey by four types. The Plainfield sandy loam is a good general-farming soil. The loamy sand, gravelly sandy loam, and sand are rather light for general farming, but when properly handled are ideal soils for truck crops and small fruits. The soils of the Plainfield series are light colored.

Two Clyde soils, the loam and sandy loam, are mapped. These are dark-colored soils with a high percentage of organic matter. The loam occurs in depressions and poorly drained areas in the uplands. The sandy loam is found in the sand plains, and its natural drainage is poor.

The Waukesha series is represented by one type, the sandy loam. This is a well-drained, dark-colored prairie soil with a level surface, and is well suited to general farming. It was the first of the soils of the county to be placed under cultivation and at present commands the highest price.

Reclaimed Muck and Peat lands are profitably used for corn and truck, and they have been found especially suited to the production of hemp, peppermint, onions, and celery.

The soil type mapped as Meadow is usually too wet and uncertain for cultivated crops and is best used for pasturage.



[PUBLIC RESOLUTION—No. 9.]

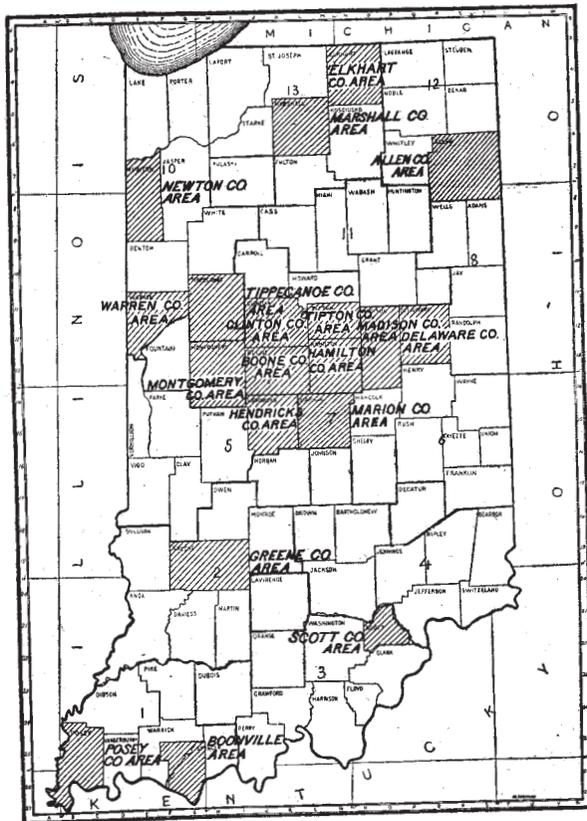
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

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.]



Areas surveyed in Indiana.

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