

SOIL SURVEY OF NODAWAY COUNTY, MISSOURI.

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DESCRIPTION OF THE AREA.

Nodaway County is located in the northwestern corner of Missouri. It is bounded on the north by the Iowa State line, on the east by Worth and Gentry Counties, on the south by Andrew and Holt Counties, and on the west by Holt and Atchison Counties. The county comprises an area of 879 square miles, or 562,560 acres.

The county includes three general physiographic divisions—the uplands, which are by far the most extensive, the terraces, and the bottom lands.

The topography of the uplands is in general rolling or maturely dissected. As a rule the divides are comparatively narrow ridges extending north and south. The numerous streams and branches flow to the south. As in other glacial-loessial regions, the streams have cut deep, narrow channels and have mud bottoms. There is considerable local variation in the topography of the uplands. In large areas along the upper course of several of the larger creeks the surface is rough and broken, owing to erosion. The presence of steep bluffs on one side of the stream with gentle slopes on the other is characteristic of the rivers of the county.

The terraces occur mainly along the rivers. They have a flat to gently undulating topography, and range in elevation from 6 to 20 feet above the adjoining first bottoms. In several instances a second terrace, considerably higher than the first terraces, is developed. These terraces are so elevated and slope so gradually into the adjoining uplands that their separation necessarily is often largely arbitrary. The terraces vary in width from only a few rods to considerably more than a mile.

The first-bottom areas along the many drainage courses comprise a large total area. They vary considerably in elevation and in places along the larger bottoms grade almost imperceptibly into the terraces.



FIG. 46.—Sketch map showing location of the Nodaway County area, Missouri.

In the lower lying areas the surface usually is flat and the soils are heavy, while the higher areas are slightly ridged and the soils are lighter in texture. The bottoms are mainly in cultivation or cleared for pasture land. Short periods of overflow are of common occurrence during the winter and spring. Drainage, especially in the larger bottoms, is deficient, owing to the tortuous channels and the slow currents of their drainage ways. A large dredge ditch, straightening the channel of the Nodaway River for a distance of 20 miles south from the Iowa State line, has recently been completed. The excellent results attending the construction of this ditch indicate that the straightening of the channels of the Nodaway, One Hundred and Two, and Platte Rivers would be of great practical benefit in preventing overflows and improving drainage conditions.

The Nodaway, One Hundred and Two, and Platte Rivers are the principal drainage ways of Nodaway County. The Nodaway River flows south through the western part of the county, forming the western boundary line for a distance of 9 miles at its lower end. The One Hundred and Two River, entering the county through three forks near Hopkins, flows southward through the central part of the county, and the Platte River flows southerly across the eastern section. White Cloud Creek, one of the largest creeks in the county, heads several miles northwest of Maryville and flows southward, leaving the county at a point about 1 mile west of the One Hundred and Two River. The main tributaries of the Nodaway River are Mill, Clear, Florida, Sand, and Jenkins Creeks. Mowry Creek and Mozingo Branch are the principal streams emptying into the One Hundred and Two River, and Honey Creek, Elm Branch, and Long Branch are the chief tributaries of the the Platte River. Wildcat Creek carries a large part of the drainage from the southeastern part of the county east into the Grand River. These rivers and creeks, with numerous smaller tributaries, constitute an adequate drainage system for all parts of the county.

A large part of Nodaway County, including the narrower stream valleys, the stream slopes, and the crests of the narrower ridges, was originally forested with a heavy growth of black walnut, elm, oak, hickory, cottonwood, maple, ash, wild cherry, crab apple, plum, haw, and other trees. The prairie section was confined to the crests of the wider ridges and to the wider bottom areas. At present the greater part of the cultivable land of the county is cleared.

The first settlement in this region was made near Browns Spring, just south of the present site of Graham, in 1839. Nodaway County was organized in 1845. The early settlers were mainly from Ohio, Indiana, Kentucky, Virginia, and Tennessee. They selected forested areas along the stream courses, the prairies being considered unfit for cultivation.

The present population of the county is largely of American descent. In the eastern part of the county there is a settlement of German Catholics, who maintain two large institutions—the Benedictine Convent near Clyde and the Benedictine Monastery at Conception. The negro population of the county is small, and is centered mainly about Maryville. The population of Nodaway County is given in the 1910 census as 28,833. The larger part of the population is rural. Maryville, the county seat, has a population of 4,762, and is the largest town in the county. It has excellent transportation facilities and several small manufacturing industries. Burlington Junction in the western part of the county and Hopkins in the north-eastern section are important towns of about 1,000 population. Numerous smaller towns are distributed throughout the county.

Railroad facilities throughout the county are good, direct connection with Chicago, St. Louis, Kansas City, St. Joseph, and Omaha being afforded. The first railroad completed through the county was the Burlington, extending north and south through about the center of the county. This road was completed to Maryville about 1869 and to the Iowa State line during 1870. Subsequently the Wabash Railroad was constructed, crossing the county in a south-east-northwest direction. The Burlington line running north and south through the western part of the county connects with the main line of the Burlington from Chicago to Denver at Villisca, Iowa. A branch line of the Chicago Great Western Railroad extends north and south through the eastern part of the county.

With few exceptions the roads of the county follow land lines, regardless of topography. They are all of dirt construction, but by means of grading and dragging are kept in good condition during the greater part of the year.

Telephones are in general use throughout the county, and all sections are served with the rural delivery of mail. An excellent system of public schools is maintained by the county.

CLIMATE.

Nodaway County has a humid climate. Owing to the elevation of the county the climate is healthful and invigorating. The annual mean temperature is about 50° F. Extreme temperatures are rare, and are of short duration.

The precipitation averages about 37 inches annually. It is well distributed throughout the year, being heaviest during the late spring, the summer, and early fall. The snowfall as a rule is not heavy, although adequate to protect growing wheat, clover, and grasses from freezes and heaving. The greater part of the soil of Nodaway County is of such character that during periods of drought

or of excessive rainfall crops do not suffer as much as in many other regions.

The average date of the last killing frost in the spring is about April 21, and of the first in the fall about October 7. The earliest date of killing frost recorded in the fall is September 13, and the latest date recorded in the spring is May 13. There is a normal growing season of about 170 days, which is sufficiently long for the production of all general farm crops. Fruit, excepting peaches, is seldom injured by extreme climatic conditions. The peach orchards are so frequently injured by freezing that little attention is given to the development of this fruit.

The data in the table below giving the normal monthly, seasonal, and annual temperature and precipitation of Nodaway County are compiled from the records of the Weather Bureau station at Maryville:

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

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.
	° F.	° F.	° F.	Inches.	Inches.	Inches.
December.....	26.2	67	-13	1.13	1.40	2.05
January.....	22.8	75	-17	1.16	.90	1.35
February.....	21.7	69	-28	1.36	1.55	.91
Winter.....	23.6			3.65	3.85	4.31
March.....	36.1	92	-4	2.02	1.52	.95
April.....	50.6	94	10	3.26	.90	.72
May.....	62.1	96	25	5.64	1.98	5.71
Spring.....	49.6			10.92	4.40	7.38
June.....	70.5	101	42	4.85	3.40	7.70
July.....	75.3	107	49	5.54	1.22	7.82
August.....	74.3	103	46	4.82	.18	4.70
Summer.....	73.4			15.21	4.80	20.22
September.....	65.7	101	28	3.47	3.52	8.05
October.....	53.5	99	16	2.46	2.04	3.05
November.....	38.2	77	-5	1.32	.20	2.23
Fall.....	52.5			7.25	5.76	13.33
Year.....	49.8	107	-28	37.03	18.81	45.24

AGRICULTURE.

The interests of Nodaway County are primarily agricultural, and it is one of the leading counties in the State in output of agricultural products. Combined stock raising and general farming, consisting mainly of grain production, is practiced throughout the county, and the general productiveness of the soil may to some extent be attributed to this system.

The early settlers were attracted to Nodaway County by its natural resources, including an extensive open range, large areas of forested land, and an abundance of water, game, and fish. The population gradually increased and agriculture progressed steadily until the time of the Civil War. The war resulted in a short period of depression, but with the reestablishment of business on a firm basis and the advent of the railways agriculture again became important, and has advanced steadily to its present prosperous condition. Only a very small part of the county is unsuited to agriculture, and such areas, as a rule, support a valuable growth of timber and of blue-grass, forming good pasture.

Nodaway County lies within the corn belt, and corn is the principal crop grown. The 1910 census reports a production of 4,560,898 bushels from 157,619 acres in 1909. A yield of almost 8,000,000 bushels from about 225,000 acres is reported in 1900.

Corn is profitably grown throughout the county. The best yields are obtained on the well-drained bottom lands and the western uplands. Where crop rotation is practiced corn usually follows clover. The sod is usually turned under in the fall, that the plant tissue may decay thoroughly before planting time. The crop is commonly listed. This is a quick means of planting, and in addition it is thought that under this method the corn withstands drought better and may be kept cleaner, and the stalk has more support where a ridge is formed about it by the last cultivation. The greatest objection to this method lies in the fact that the fields, especially in rolling areas, are subjected to more severe erosion. Corn planters are in common use, both when the corn is drilled and when it is planted in check rows. In the first cultivation the common drag harrow is generally used, the field often being harrowed before the corn has come up. This is a quick and efficient means of pulverizing the soil and eradicating weeds. An implement known as the "snake killer," consisting of a combination of disks and shovels, is used for cultivating the listed corn. The six-shovel cultivator is commonly used for planted corn and for listed corn after the second cultivation. Where corn is followed by wheat, it is commonly cut either in the early fall for silage or at a slightly later date for fodder, otherwise

it is husked while standing, the stalks furnishing roughage for grazing cattle during the early winter.

The greater part of the corn grown in the uplands is the Reid's Yellow Dent or a closely related variety. The remainder is mainly the St. Charles White. In the bottoms the Boone County White, St. Charles White, and Reid's Yellow Dent are the most popular varieties. Considerable interest is being taken in the production of good seed corn.

Wheat has become a very important cash crop in Nodaway County during the last few years. A total area of 16,632 acres is reported in this crop in the 1910 census, with a production of 255,109 bushels. With proper management yields of 25 to 40 bushels per acre are obtained.

Wheat generally follows corn where a rotation is practiced. The corn is usually removed and the field double-disked, harrowed, and drilled to wheat. Often the wheat is drilled between the rows of standing corn, using a 1-horse drill. Where wheat follows wheat, oats, or clover the stubble is turned under, harrowed, and drilled. In rotations in which wheat follows wheat a good practice consists of sowing clover in the spring to be plowed under with the stubble the following fall. Wheat is usually sowed at the rate of $1\frac{1}{2}$ bushels per acre. This is a rather heavy seeding, but results in a less rank growth of straw. The wheat is drilled in as soon after the first week in September as possible to avoid the danger of injury by the Hessian fly and to get a good growth, especially of the root system, before the winter freezes and consequent heaving.

The crop ripens during the latter part of June or the first part of July. It is cut with the common grain binder and shocked. The grain is generally thrashed from the shock, although in many cases, especially on the smaller farms, it is stacked before being thrashed. Winter wheat only is grown, the bearded varieties predominating.

Oats as a rule are grown only for home consumption. The 1910 census reports a production of 452,082 bushels from a total of 19,945 acres. Rust-proof varieties are grown. In crop rotation oats usually follow corn. The field is either plowed or disked and harrowed. The oats are sown during the latter part of March or early in April at the rate of about $2\frac{1}{2}$ bushels per acre. The seed is either sowed broadcast or drilled. Very good average yields are obtained throughout the county. The oats often serve as a nurse crop for the following clover crop.

Only a small acreage in Nodaway County is devoted to rye. This crop is grown mainly for winter and spring pasture and as a green manuring crop. The 1910 census reports 917 acres in rye, with a production of 12,156 bushels. Barley was grown on 340 acres in 1909

and produced 4,571 bushels. A total of 2 acres was devoted to tobacco, with a yield of 1,505 pounds.

The soils of the county are admirably adapted to red clover. Where sown alone or in connection with timothy this clover makes an excellent hay crop. In addition, the growing of red clover has a beneficial effect upon the following crop. It is commonly used in rotation with corn and wheat. Red clover may be seeded either in the fall several weeks before killing frosts or early in the spring during a time of alternate freezing and thawing. Where sown alone it is usually seeded at the rate of 18 to 20 pounds per acre. When sown with a nurse crop 10 to 15 pounds per acre are used. It is sometimes difficult to obtain a good stand, owing to prolonged summer droughts. The yields vary from $1\frac{1}{2}$ to 3 tons of hay per acre.

Alsike, where grown in connection with timothy, produces a hay of excellent quality, and may be used to advantage in areas too wet for red clover. It is a perennial and very hardy. A somewhat smaller amount of seed per acre is required than that used in seeding red clover.

Sweet clover, at present undomesticated, grows luxuriantly along the roadside, especially throughout the glacial soils.

White clover is quite common in the bluegrass pastures, where it grows naturally.

Alfalfa is attracting widespread attention and is being grown in fields ranging in size from 5 to 40 acres throughout the county. The glacial soils of the county, probably because of their high lime content, frequently support an excellent growth of alfalfa. On the average loessial soils the addition of lime is necessary. For alfalfa the seed bed is carefully prepared, the soil being plowed either during the fall or the spring preceding the growing season. The seed is planted in June or as late as August, and is usually sown broadcast, at the rate of about 20 pounds per acre, after which it is covered with a light harrow. Inoculation with soil from a successful alfalfa field is beneficial. Three to four cuttings per year, averaging 1 ton of hay per acre each, are made. Cultivation, consisting of a thorough double disking both ways, after the first and second cuttings, has been found beneficial on fields in which weeds are prevalent. The main obstacle met with in the production of this crop is the usual occurrence of a rainy season at the time of the first cutting.

Timothy is grown extensively in connection with red clover for hay. A small acreage of timothy alone is grown for the seed.

Bluegrass thrives on all the soils of Nodaway County. Its seeding is not necessary, as a rule, as it starts naturally in any land left

uncultivated. Where this grass is seeded it is sown at the rate of 15 to 20 pounds per acre. It furnishes excellent pasturage during all the growing season, with the exception of a few weeks during midsummer. The practice of stripping the heads for seed is becoming quite common.

Cowpeas are grown to some extent. This crop is grown for hay, and does well in areas where it is difficult to secure a stand of clover. Cowpeas produce an excellent quality of hay when cut just as the pods are ripening. In well-balanced rotations they are grown with corn for silage or drilled between the rows where corn is to be "hogged down". The best results are obtained from this crop where it is pastured and the greater part of the growth is retained on the field. The Whippoorwill, New Era, and Red Ripper varieties are well suited to this region.

The soils of Nodaway County, especially the loessial soils, are well adapted to orcharding. Only apples are grown on a commercial scale. There are a number of large orchards in the county, mainly in the vicinity of Skidmore in the southwestern part of the county and near Ravenwood in the eastern part. A number of the larger orchards are well cared for and are very profitable. The Jonathan, an early winter apple, and the Ben Davis, a later variety, are the most popular varieties. The Winesap, Grimes Golden, and Arkansas are also grown extensively. Cherries and plums produce well but receive little attention. Peaches, as a rule, are not successful. The value of orchard products, including small fruits and nuts, is given as \$317,898 in 1909.

Small fruits and vegetables of all kinds do well throughout the county and are grown in quantities sufficient to supply local demands. The 1910 census reports a production of 131,373 bushels of potatoes from 1,574 acres. Sweet potatoes receive but little attention. A total of 1,169 acres is devoted to other vegetables, according to the census of 1910.

The grain crop is used largely for feeding live stock, the raising of which is an important adjunct to farming in all parts of the county. The value of live stock in the county is given in the 1910 census as \$6,585,619, and during 1910, 30,983 head of cattle, 105,830 hogs, and 10,353 sheep were shipped out of the county.¹

The cattle are mainly grade Aberdeen Angus or Shorthorn. The hogs are generally Poland China, Berkshire, or Duroc-Jersey. They are usually raised in conjunction with the cattle. The ravages of cholera have had a demoralizing effect upon the raising of hogs. The sheep in the county are usually found in small flocks. When handled in this way on the average farm they prove highly profit-

¹ Missouri Red Book, 1911, State Bureau of Labor Statistics.

able. Pure breeds and grades of Hampshire, Shropshire, and South-down are most common. The horses in the county are of excellent grade. Draft breeds predominate. Pure-bred Percheron, Belgian, and Shire stallions are kept on a number of the farms. There are no large horse farms, but practically every farm produces one or more colts annually. The mules in the county are prevailingly of draft type.

Dairying is practiced to a small extent. The value of dairy products, excluding the home use of milk and cream, is reported in the 1910 census as \$336,454.

During 1910, 1,124,944 pounds of live poultry, 97,054 pounds of dressed poultry, and 900,570 dozen eggs were shipped out of Nodaway County. The 1910 census gives the value of poultry and eggs produced in 1909 as \$522,690.

By far the greater part of the soil of Nodaway County, although originally heavily forested, is now cleared and cultivated. The 1910 census reports 539,949 acres in farms. Of this total, 497,934 acres are improved. The average size of the farms is about 140 acres. About 64 per cent of the farms are operated by the owners. The total value of land and improvements, excepting buildings, is reported as \$43,207,723. Only a small percentage of the land is unfit for cultivation. The rougher areas are in wood pasture. In this rolling country erosion is a serious obstacle to farming. The washing of the soil is best counteracted by careful cultivation, filling in the smaller gullies with brush, and constructing dams and tile drains along the streams.

The soils of Nodaway County are naturally strong and productive, and commercial fertilizers are not extensively used. They are most economically improved and maintained in good condition by systematic crop rotation and manuring. Large quantities of barnyard manure are generally available, and this is used to advantage on all the soils of the county.

The rotation of corn, wheat, and clover is practiced in a general way over a large part of the county. In many cases corn or wheat is grown for several successive years. Best results are had, however, where the farmer adheres to some definite, short-term rotation, such as corn the first year, corn or wheat the second year, and wheat the third year, followed by clover and timothy for one or two years. Cowpeas are a good substitute for clover where difficulty is experienced in securing a stand of clover.

In view of the large acreage devoted to farming and the heavy yields obtained the farm machinery is in general inadequate. Frequently the farm implements are not properly housed and cared for. The general farm improvements are good and are indicative of a condition of prosperity throughout the county.

There is considerable variation in the price of farm land, the range being from \$50 to \$200 an acre. The highest prices prevail in the western half of the county, where the soil is largely loessial. In the eastern section, where the glacial soils predominate, land values are lower. The average value of land per acre is given in the 1910 census as \$80.02, showing a marked increase over the average value reported in 1900, which was \$37.39.

Farm land is rented on both a cash and share basis. Under the share system the farms are generally rented for one-half of the crops produced, with special arrangements with respect to buildings, seed, stock, etc. Cash rents vary from \$3 to \$8 an acre.

Labor is generally scarce, although the introduction of labor-saving machinery has a tendency to relieve this condition. Laborers are paid from \$25 to \$35 per month, with board. Day laborers receive \$1.50 to \$3 per day, depending upon the season and character of labor.

SOILS.

The soils of Nodaway County fall into two general groups, the upland soils and the bottom-land soils. The former are by far the most extensive. On the basis of their formation they are divided into two general classes, glacial soils and loessial soils. The bottom lands also comprise two general divisions, the terraces and the first bottoms.

The material which gives rise to the glacial soils of the uplands represents the remnants of a deposit known as the Kansan glacial drift. This drift extends over a large area, including much of the northern part of this State. It varies from a few feet to many feet in thickness and is characterized by the presence of clay, sand, stones, and boulders. The limestone, sandstone, and shale formations which underlie this material outcrop occasionally at the base of steep bluffs along stream courses. The soils derived from this glacial material are classed in three series—the Shelby, Miami, and the Carrington—the first two named comprising the greater part of the glacial soil of the county. The soils of these two series are characterized by their light color and sharp topography, and, in the case of the Shelby, by its sand, stone, and gravel content. Their development is limited in the western part of the county, but gradually increases toward the east, so that as the eastern county line is approached they become the predominating soils. The Carrington soil is characterized by its clay, sand, and gravel content, dark color, and even topography. The gentle slopes of this soil are less susceptible to erosion than the slopes of the Shelby, and there has been a considerable accumulation of organic material, resulting in the characteristic dark color of the soil.

The loessial soils of the county are derived from eolian or wind-blown material, deposited over the glacial drift. The material is supposed to have been brought in from the Missouri River flood plain. It is not peculiar to the Missouri River, but is also encountered along the valley of the Mississippi River and its other larger tributaries. This deposit is thickest next to the river flood plains and gradually becomes thinner away from it. In the western part of Nodaway County the deposit is so thick that only on the steeper slopes has it been eroded away to a sufficient extent to expose the underlying glacial material. The purely loessial material decreases in extent toward the eastern part of the county. The loessial deposits in this county give rise to two members of the Marshall series.

The terraces of the bottom-land region include extensive areas of productive soil. They are generally level, and range from 5 to 20 feet in elevation above the adjoining alluvial soils. They undoubtedly represent a part of the flood plain of the preloessial streams, which was covered by loessial deposits and subsequently eroded to its present form. The soil of the terraces is of loessial origin, and closely resembles the Marshall soils in color and texture. It is classed in the Bremer series.

The bottom-land soils, with one exception, the Wabash silt loam, colluvial phase, occur along the larger streams. These soils are classed with the Wabash and Genesee series. They are derived from loessial and glacial material, eroded, reworked, and deposited by the various large streams along their channels during times of overflow. This material has been assorted, the coarser material being deposited along the higher areas by running water in time of high overflow, and the finer material being laid down in the lower lying areas by slow-moving or standing overflow water. The Wabash silt loam, colluvial phase, occurs along the smaller drainage courses and in places as overwash bordering the larger stream bottoms. This soil is of local origin, usually being washed directly from the adjoining upland.

The following table gives the names and the actual and relative extent of each soil mapped in the county:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Marshall silt loam.....	229,696	40.8	Wabash silty clay loam.....	11,584	2.1
Shelby loam.....	140,160	24.9	Wabash clay.....	6,784	1.2
Wabash silt loam.....	63,616	16.7	Genesee very fine sandy loam.	1,984	.4
Colluvial phase.....	30,400		Miami silt loam.....	1,792	.3
Carrington silt loam.....	52,352	9.3			
Bremer silt loam.....	12,416	2.2	Total.....	562,560
Marshall silty clay loam.....	11,776	2.1			

MARSHALL SERIES.

The Marshall series includes the dark-colored upland loessial soils, which predominate in the great prairie region of the Central West. The soils of this series are characterized by a large content of organic matter in the surface soils, which gives them a dark-brown to black color and distinguishes them from those of the Knox series. The topography is level to rolling, and artificial drainage is usually necessary to secure the best results.

MARSHALL SILT LOAM.

The soil of the Marshall silt loam ranges from about 12 to 20 inches, averaging about 16 inches in depth. It consists of a very dark-brown to grayish-black rather heavy silt loam, approaching a silty clay loam in texture in places, especially in the western part of the county. The subsoil is typically a yellowish-brown silty clay loam, which becomes heavier with depth until in the lower part it consists of a light, friable, silty clay. In many places the subsoil is a silty clay loam to a depth of 40 inches or more.

For so extensive a type the Marshall silt loam is remarkably uniform. There is a slight variation, however, between the development in the western part of the county and that in the eastern section. In the former the soil is deeper and heavier and the subsoil lighter. Toward the east the surface soil gradually becomes shallower and lighter, and the subsoil slightly heavier. In places in the eastern areas a slight grayish mottling is noticeable in the lower subsoil.

The Marshall silt loam comprises the greater part of the upland loessial soil of the county: It has a comparatively rolling topography, and surface drainage is good to excessive. The open, porous subsoil permits excellent natural underdrainage. The type is retentive of moisture, so that crops withstand prolonged periods of drought. In some places tiling is advantageous in furnishing an underground channel to remove seepage water rapidly, allowing the surface soil to absorb an increased amount of moisture and decreasing run-off and consequent erosion. Owing to continuous cultivation, the type is in many places subject to severe washing, which sometimes results in the formation of destructive gullies. Numerous brown spots or galled areas occur along the more rolling slopes where the surface soil is badly eroded, leaving the subsoil exposed. The material of this type at any depth may be made almost as productive as the surface soil by adding decaying vegetable matter, so that by turning under barnyard manure and a green crop, such as clover, the productiveness of these eroded spots may be greatly improved. The

prevention of erosion is the most serious problem confronting the farmers on this type.

The Marshall silt loam is naturally a strong, productive soil. In some fields corn has been grown continuously for a period of 15 years or more and still produces good average yields.

The raising of live stock on a comparatively extensive scale has been an important factor in maintaining the general productiveness of this soil.

Originally the more nearly level areas of this type were largely prairie land. A forest growth, consisting mainly of walnut, elm, oak, cottonwood, and wild cherry extended up the stream slopes and over the narrower ridges. Practically all of the type is now cleared and in cultivation.

The Marshall silt loam is considered the best upland corn soil in the United States. It occupies a large total area in the corn belt. Excellent yields are obtained during normal seasons, and during seasons of extreme drought the yields are greater than the average for the county. The soil is also adapted to wheat, which is receiving increasing attention. Bearded varieties, owing to their freedom from lodging and the heavy yields obtained, are commonly grown. The yields are equalled only in occasional bottom areas, averaging about 30 bushels per acre. Oats do well, but are not considered a profitable cash crop and are grown as a rule only for home use.

Legumes grow luxuriantly upon this soil. Red clover is the most common, although it is sometimes difficult to start this crop because of drought. The soil is well suited to alfalfa, and even during droughty seasons three to four cuttings are generally made. In addition to the hay produced, good pasture is usually furnished. Many fields are devoted to cowpeas, which are usually planted in the standing corn. Timothy is grown extensively, usually in connection with clover. Bluegrass does particularly well and is grown both for pasturage and for seed.

The production of apples on a commercial scale is an important industry on this type. Peaches, plums, cherries, and pears do well. Small fruits and vegetables produce excellent crops, but are grown only for home consumption.

The farms over all the type are very generally well cared for and improved. Land values range from \$75 to \$150 an acre, depending upon improvements, general condition of the soil, and distance to market.

MARSHALL SILTY CLAY LOAM.

Typically the Marshall silty clay loam, to a depth of about 12 inches, consists of a dark-brown silty clay loam. In many places the

soil to a depth of about 4 inches is a heavy silt loam, which is somewhat darker than the typical soil. At about 12 inches the soil becomes light yellowish brown.

In texture this type is rather variable. In some places the material is a silty clay loam to a depth of 40 inches or more, and in others it is a silty clay loam, grading into a friable silty clay at about 24 inches. At times a slight grayish mottling is encountered in the lower subsoil section. In several instances, especially in the eastern section of the county, areas in which the soil is a silt loam, but shallower and of the typical color, are mapped.

This soil is distributed throughout the county. Its occurrence is more general in the rolling western and eastern sections than in the more nearly level central part. In the western part of the county this type occurs as narrow loessial ridges from which erosion has removed the greater part of the black surface soil. In the eastern part it occurs as loessial crests of the high, narrow ridges, the slopes of which are composed of glacial material.

The Marshall silty clay loam is apparently of true loessial formation. In the deep loessial region of the western part of the county the material is uniform throughout the soil section and of the same character as the loess mapped in other regions. In the extreme eastern section of the county a layer of heavy material, possibly of glacial origin, is encountered in places at depths of 28 to 30 inches. Owing to the depth of this glacial material it has no noticeable effect upon the overlying soil.

Originally this type was heavily forested. At present practically all of it is cleared and cultivated. Owing to the fact that eroded loessial material, upon being aerated and supplied with humus, is apparently as productive as the original uneroded soil, the eroded areas of this type, particularly in the western part of the county, when not too rolling, are about equal to the typical soil in agricultural value. In general, this type is comparable in value with the Marshall silt loam.

The crop adaptations of this type are identical with those of the Marshall silt loam. It is mainly in need of humus, which is best supplied by following a systematic crop rotation and plowing under green crops and barnyard manure. It is necessary to exercise care in cultivating this soil in order to avoid erosion and the consequent formation of gullies.

BREMER SERIES.

The Bremer series includes types with dark-brown or black soils and yellow or light-brown heavy subsoils. Scattered gravel may be present in soil or subsoil but never in sufficient quantity to impair the moisture-holding capacity. These soils cover terraces above the

limit of overflow within the glaciated region of the central States. They differ from the soils of the Waukesha series in the absence of limestone gravel and bowlders and from the Sioux and the Hempstead series in the absence of beds of gravel in the lower subsoil or the upper substratum. The topography is level to gently undulating and the drainage is usually good.

BREMER SILT LOAM.

To an average depth of 20 inches the Bremer silt loam consists of a dark-brown to black silt loam. At times a very faint grayish cast is noticeable in the lower soil section. At 20 inches the soil becomes heavier, grading into a brown, friable silty clay loam, which at about 30 inches passes into a light-brown, friable silty clay. Occasionally the silty clay loam subsoil continues to the depth of the soil section.

There are several variations which have some influence upon the value of this type. In small, irregular areas the subsoil is rather heavy and the surface soil is light in color and shallow. These areas occur chiefly along the Platte River and but for their small size would be mapped separately, possibly as the Chariton silt loam. Along the outer edge of a terrace in sec. 14, T. 66 N., R. 37 W., along the Nodaway River, a narrow strip of soil, consisting of a dark-brown coarse loam underlain at about 12 inches by light-brown fine sandy clay, which in turn grades into a yellowish-brown sand, is encountered. This area is too small to be satisfactorily separated, and is included with the main type.

The Bremer silt loam occurs along the main streams of the county. It is distinctly a terrace soil and the boundaries between it and the uplands on the one side and the first bottoms on the other are generally well defined. It ranges from 6 to 25 feet above the adjoining alluvial soils. In its highest areas erosion has often resulted in a topography which makes the line between it and the adjoining uplands rather indistinct in places.

The topography of this type varies from almost level or gently undulating to very gently rolling, with a slight slope toward the first bottoms. This topography is responsible for the accumulation of large quantities of organic matter resulting in the deep, dark-colored surface soil. Drainage as a rule is good. This soil bears a close resemblance to the Marshall silt loam in color, depth, texture, and structure.

The Bremer silt loam at one time supported a growth of prairie grass and some timber. At present practically all of it is cleared and in cultivation. It is a naturally productive soil, and constitutes some of the most valuable land in the county. Owing to its topography

erosion has in a few places proved destructive. The bad effects of continuous cropping are not so apparent as upon some of the upland soils.

All the general farm crops suited to this region are grown with good results on this type. Corn yields 50 to 80 bushels per acre, wheat 25 to 40 bushels, and oats 30 to 50 bushels. Bluegrass makes an excellent growth, and clover, alfalfa, and timothy do well. The soil is well adapted to fruit, small fruit, and truck crops.

Land values range from \$100 to \$200 an acre, depending largely upon location, the general topography, and improvements.

SHELBY SERIES.

The Shelby soils are predominantly brown to dark brown. The subsoils are composed of yellow, reddish-yellow, or light-brown sandy clay, heavier than the surface soils. The subsoils frequently contain iron pipes and nodular masses and streaks of calcareous material. These soils are derived from the Kansan drift, and occur in a region of complete dissection and rolling topography.

SHELBY LOAM.

The Shelby loam consists of a brown loam, grading at a depth of 8 to 12 inches through light brown to a yellowish silt loam into yellowish brown, mottled with gray material consisting of plastic clay, sand, and gravel, and approximating a sandy clay. Numerous lime concretions and calcareous streaks occur throughout the soil section. There is a noticeable variation in the texture and structure of the subsoil of this type. There are occasional areas of this soil in which the surface is distinctly gray. In general, however, it is considerably darker in color and has a coarser, less compact subsoil than the typical Shelby loam as mapped in the northeastern counties of Missouri.

The Shelby loam is derived from a weathered remnant of glacial till known as the Kansan drift. Since this formation was covered by loessial deposits, soils derived from it are encountered only where the loess has been removed by erosion. Owing to the great depth of the loessial deposits in the western part of the county, erosion has succeeded in exposing the glacial material only along the sharper and more abrupt breaks, whereas in the extreme eastern part, where the loessial deposit is comparatively thin, glacial material gives rise to far the greater part of the soils.

This soil is, next to the Marshall silt loam, the most extensive type in the county, and covers one-fourth the total area. It appears in every township, along the minor streams.

The topography of the Shelby loam varies from rolling to broken. The roughest areas in the county are included with this type. Owing to its rolling topography, together with the coarse, loose texture of the soil and the heavy character of the subsoil, this soil is liable to serious erosion. Under careless cultivation the greater part of the surface soil has been washed away in places in the more broken areas. The rough areas are best utilized as bluegrass pasture land. The soil of the less rolling areas is easily improved through the addition of organic matter by applying barnyard manure or growing green manuring crops and legumes as well as through the use of winter cover crops and the employment of proper rotations.

The underdrainage is deficient and capillary action is restricted. Crops are subject to injury by extreme droughts.

Originally this type was forested. Practically all of the tillable areas are now cleared and in cultivation. The present forest growth, consisting largely of oak, is confined mainly to the rough stream slopes and bluffs.

During years of normal rainfall crop yields are generally good. The soil is well suited to the general farm crops grown in the county. Corn is the crop most extensively grown, and yields from 25 to 50 bushels per acre during favorable seasons. The practice of listing has proved injurious to this soil in that it has induced serious erosion in many cases. Plowing and check or drill planting is the better practice. Wheat produces from 15 to 30 bushels per acre and oats from 20 to 40 bushels. Bluegrass makes an excellent growth. Many of the more rolling areas now in cultivation are better suited to permanent pasture. Alfalfa, red clover, and cowpeas do well. The various truck and small-fruit crops produce excellent results on this type but are grown only for home use.

This type is well adapted to stock raising and dairying. Bluegrass pastures are more economically maintained than on the higher-priced soil areas, and the proper use of the barnyard manure produced results in materially increased crop yields.

Where the type is cultivated some such rotation as corn the first year and wheat or oats the second year, followed by clover and timothy for two years, gives good results.

The value of the Shelby loam ranges from about \$40 an acre for areas including rough land to \$125 an acre where the slope is gentle and the soil is in a good condition.

MIAMI SERIES.

The Miami series is one of the most important of the glacial province. The soils are brown, light brown, or grayish, and are underlain by yellowish and brown heavier-textured subsoils. Mot-

tlings of brown and light gray are present in the subsoils in many places. The surface drainage is usually good, but artificial drainage is necessary in some of the heavier types. The soils are in the main derived, through weathering, from glacial till of a generally calcareous nature. The series represents considerable range in texture, but in Nodaway County only the silt loam type is found.

MIAMI SILT LOAM.

In several small areas in Nodaway County the soil, which is derived from weathered glacial material, has prevailingly a silt loam texture and lacks the sand and gravel content of the Shelby loam. Such areas are mapped as the Miami silt loam.

This soil consists of a brownish-gray, rather loose and powdery silt loam, which grades at about 6 inches into a light yellowish brown, plastic silty clay of quite uniform texture to a depth of 40 inches or more. Gray mottlings occur in the lower subsoil, becoming very prominent in the lower depths. Iron stains and concretions are numerous in the subsoil.

The Miami silt loam occupies the crests of the high, narrow ridges in the eastern part of the county.

The type was originally forested, mainly with scrubby white post, black, and red oak and hickory. The greater part of the type is cleared and cultivated. It is among the least productive soils of the county. The content of organic matter is low. This condition is best remedied by employing a crop rotation including the frequent growing of legumes, and by turning under an occasional crop of clover and large quantities of barnyard manure. Crops are subject to injury by protracted drought. Frequent shallow and level cultivation is necessary on this soil.

Corn, oats, clover, and timothy are the crops best suited to this soil. Bluegrass makes excellent pasturage.

Areas of Miami silt loam are valued at \$30 to \$75 an acre. Owing to their small size they rarely, if ever, constitute an entire farm.

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

Mechanical analyses of Miami silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
343019.....	Soil.....	0.0	0.2	0.3	1.1	8.3	71.2	18.8
343020.....	Subsoil.....	.0	.2	.2	.8	6.8	62.5	29.4

CARRINGTON SERIES.

The Carrington series includes soils derived, through weathering, from glacial till, with little or no modification from admixture of loessial deposits. The series is developed in the Central and Western Prairie region, and consists mainly of prairie soils. The soils are generally black in color, ranging in some cases to dark brown. The subsoils are lighter colored, generally having a light-brown or yellowish color. The topography is gently undulating to rolling, though in some instances nearly flat areas are found. One type, the silt loam, occurs in Nodaway County.

CARRINGTON SILT LOAM.

To depths ranging from 12 to 16 inches the Carrington silt loam consists of a dark-brown to black, medium to heavy silt loam. In places a slight grayish tinge is noticeable in the soil. At about 16 inches the soil grades into a black clay loam, and at about 18 inches a mottled drab and yellowish-brown, plastic clay, which becomes somewhat lighter in color with depth, is encountered. Glacial pebbles and sand usually occur throughout the subsoil, especially in the lower part.

This type has its principal development in the central and eastern part of the county, along the heads of the smaller drainage ways. It covers a large aggregate area.

The topography of the Carrington silt loam is much more gently rolling than that of the Shelby loam and the Miami silt loam. The type occupies the most gradual long stream slopes.

This soil is derived from essentially the same formation as are the Shelby and Miami soils, the weathered glacial till of the Kansan drift deposit. Owing to its gentle topography, organic matter has accumulated, producing a dark-colored, productive glacial soil.

The heavy subsoil of this type is not favorable to the rapid percolation of water, so that there is a heavy run-off of rain water. Owing to its gentle topography and high content of organic matter, however, the soil is not susceptible to erosion, except in fields where continuous cropping is practiced.

Originally a large part of this type was forested. At present it is mainly cleared and in cultivation.

The Carrington silt loam is naturally a productive soil, although, owing to its heavy subsoil, crops are subject to injury by long periods of drought or excessive rainfall. In many cases crop yields have been lowered by continuous cropping. The productiveness of the soil is most effectively restored by plowing under green crops and applying barnyard manure, particularly in thin, eroded areas, and by following a systematic rotation of cultivated and unculti-

vated crops. This type is generally in need of tiling, for reclaiming seepage areas and improving the condition of the subsoil.

The Carrington silt loam is well adapted to the growth of all the general farm crops suited to this region, and heavy yields are secured during normal seasons. Corn produces from 40 to 60 bushels, wheat 20 to 30 bushels, and oats from 25 to 50 bushels per acre. Bluegrass makes an excellent pasture and seed crop. Clover and timothy, grown alone or together, give good yields of hay and forage. Alfalfa does well, three to four cuttings of about one ton each being obtained. Truck and small fruits are grown successfully. Orchards produce well but are not so long lived as upon the loessial soils.

The value of this land ranges from \$75 to \$150 an acre, depending upon its location, improvement, and general productiveness.

WABASH SERIES.

The Wabash soils are prevailing dark brown to black and the subsoils drab or gray. The dark color is due to the presence of a large content of organic matter. These soils are developed in the first bottoms of streams in the Central Prairie States. They extend for long distances along the Mississippi River. The material is derived principally from the loessial and associated soils of the region.

WABASH SILT LOAM.

To a depth of 14 to 18 inches the Wabash silt loam consists of a dark-gray to grayish-black, mellow, even-textured silt loam. Below this depth the soil gradually becomes heavier in texture, ranging from a dark-gray, friable silty clay loam to a black sticky clay. The lighter subsoil is usually encountered along the smaller streams and in narrow areas bordering the larger streams, and the heavier subsoil in the wider areas and bordering the heavier types. The heavier soil material is usually darker colored and shallower than that of lighter texture. Thin layers of grayish silt occur irregularly throughout the soil in the lighter areas.

The Wabash silt loam occurs along the various streams of the county. In the wider bottom areas along the rivers it rarely extends across the entire bottom, but forms a strip following the stream courses and often the bluff line. With its colluvial phase this soil is the third most extensive soil mapped, and covers one-sixth of the county.

This type is an alluvial soil consisting of material eroded from the loessial and glacial uplands, reworked and deposited along the

valleys of the various streams during periods of overflow. It occupies the first bottoms and is subject to occasional overflow. A large part of this overflow can, in many cases, be avoided by straightening the stream channels, ditching, and diking. Numerous small ditches have been dug along the various bottoms.

The greater part of this type was originally forested, and, although most of it is now cleared and in cultivation, a part is in timber and pasture land.

The Wabash silt loam is a strong, productive soil. The occasional overflows serve in a way to improve the lower-lying areas. Corn is the principal crop, and yields from 40 to 80 bushels per acre. Wheat does particularly well, some of the highest yields in the county being reported from fields on this soil. There is a risk, however, of the crop growing too rank and lodging. Red clover and alfalfa are grown successfully on the better-drained areas and alsike on the wetter areas. The type is well suited to bluegrass, and a large part of it is used for pasture land. Orchard trees, small fruits, and vegetables are grown successfully.

Land of this type ranges in value from \$75 to \$150 an acre, depending upon location and drainage.

Wabash silt loam, colluvial phase.—The colluvial phase of the Wabash silt loam consists of an accumulation of material which has been eroded from the bordering slopes and deposited in narrow bands along the small drainage courses or in a few cases as overwash along the larger stream bottoms. Typically the soil is a grayish-black, mellow silt loam to a depth of about 18 inches, where it gradually becomes heavier, passing through a silty clay loam into a clay which is often quite plastic at greater depths. The soil is grayish black throughout its profile. Iron stains are numerous in the lower depths. Considerable variation is encountered in this phase, since, owing to its method of formation, it is influenced by the surrounding parent material. In some areas the material varies from a black silt loam of very shallow depth, immediately underlain by clay, to a light grayish-black silt loam uniform to a depth of 40 inches or more.

This phase occurs in small areas throughout the county. Its topography varies from rolling or ridgy to flat as it merges with the true alluvial soils.

This soil contains a high percentage of organic material and is very productive. It is adapted to all the crops commonly grown on the main types. It is usually included in the same field with the bordering upland type, and is therefore used mainly for bluegrass pasture along the rougher areas and for cultivated crops where bordered by long, gentle slopes.

WABASH SILTY CLAY LOAM.

To a depth of about 16 inches the soil of the Wabash silty clay loam consists of a dark-gray to grayish-black silty clay loam. This gradually passes into a dark-drab to black, heavy, plastic clay. Some variation occurs in the texture of this soil, since it often lies intermediate between the Wabash clay and Wabash silt loam, and, being influenced by these types, grades from heavy to light. Occasionally lenses of a gray silty loam occur throughout the soil section in areas of lighter material.

The type occurs mainly as small, irregular areas along the rivers and several of the larger creeks of the county. It very seldom adjoins the stream channel on the one side or the upland upon the other.

The Wabash silty clay loam is an alluvial first-bottom soil, derived from reworked glacial and loessial material eroded from the uplands. Its elevation is slightly below that of the Wabash silt loam, and its surface is generally level. Drainage is deficient. The type is frequently inundated, owing to the accumulation of run-off water from the uplands rather than to overflow of the streams. Surface ditches dug from these areas to the drainage courses greatly relieve this condition. After good surface drainage has been obtained tiling is generally necessary.

The greater part of this soil is in cultivation. It originally supported a growth of prairie grass with a few areas of timber.

The Wabash silty clay loam is a strong soil capable of producing excellent crops. The main obstacle in cultivating this soil, in addition to the poor drainage of occasional areas, is the difficulty in tilling the areas of heavier material. Its tilth is improved by incorporating organic matter with the soil. Fall plowing also is beneficial.

Very good yields of corn, wheat, timothy, and red and alsike clover are obtained. A large part of the type is used for bluegrass pasture.

Owing to its variation in texture and drainage and to the small, irregular areas in which it occurs, the type has a wide range in value. It sells for \$50 to \$125 an acre.

The results of mechanical analyses of samples of the soil and subsoil of the Wabash silty clay loam are given in the following table:

Mechanical analyses of Wabash silty clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
343011.....	Soil.....	0.0	0.5	0.3	0.8	6.2	66.1	25.9
343012.....	Subsoil.....	.2	.4	.4	.8	7.2	62.3	28.5

WABASH CLAY.

To a depth of 5 to 8 inches the Wabash clay consists of a grayish-black clay loam to silty clay. The soil has a high organic-matter content and disintegrates into small cubes upon exposure to air and moisture. At about 8 inches the soil is heavier, averaging a faintly grayish-black, plastic, tenacious clay. The color gradually becomes lighter with depth, averaging a dark drab at 40 inches. Thin reddish streaks are occasionally noticeable in the lower depths. Iron concretions are numerous.

The Wabash clay, locally known as "gumbo" land, comprises the low-lying areas of heavy material occurring in the bottom lands of Nodaway County. It is encountered mainly in the bottoms of the rivers. It rarely adjoins the drainage channel on the one side or the upland on the other, but occupies depressions between the two. The type has been subject to constant inundation, and owing to its poor natural outlets surface water is removed mainly by evaporation. Under such conditions only very fine soil particles have been deposited, resulting in the formation of a very fine textured clay. The decay of the water-loving plants which flourished over the type has furnished the large content of organic matter. The present natural growth consists largely of various water grasses. By means of ditching, many of these areas have been made suitable for agriculture.

Owing to its high content of plant food this soil is naturally productive. Although it produces only fair yields during seasons of normal or excessive rainfall, during a season of drought its crop yields are good. Tillage is difficult, especially during the first few seasons of its cultivation. Owing to its tendency to puddle and bake, the soil should not be worked when too wet, and if allowed to become too dry before breaking it is difficult to handle. This soil is generally acid or "sour." The liberal application of burnt lime tends to improve the soil structure as well as to correct its acidity. Fall plowing is beneficial.

During the season of 1913, one of extreme drought, corn yielded 50 to 75 bushels per acre on this type. Wheat and oats also produced good yields, although these crops make a rather rank growth of straw during normal seasons. Timothy and clover produce $1\frac{1}{2}$ to $2\frac{1}{2}$ tons of hay per acre. Alsike is perhaps the legume best suited to this soil. Bluegrass makes excellent pasturage. Some of the wetter areas support a growth of the natural grasses.

As there are no very extensive single areas of this soil, it rarely constitutes an entire farm. It is commonly used as pasture land and is kept well fenced and improved.

GENESEE SERIES.

The soils of the Genesee series are brown, varying from dark brown to grayish brown. They are developed mainly along the major streams and their tributaries throughout the northeastern glaciated region, particularly where the Dunkirk, Volusia, Miami, and Ontario series constitute the principal upland soils, but may occur elsewhere in the glaciated region or even a short distance south of it, where the main streams flow from areas of these series. The Genesee soils are alluvial in origin and subject to frequent or annual overflow. Only the very fine sandy loam type is found in Nodaway County.

GENESEE VERY FINE SANDY LOAM.

The Genesee very fine sandy loam to a depth of about 15 inches consists of a grayish-brown very fine sandy loam. This grades into a slightly heavier very fine sandy loam of grayish-brown color, and this in turn into a light grayish-brown very fine sandy loam which becomes rather coarse at about 24 inches. The type is variable; ranging from ridges and mounds of very fine sandy loam to depressions of heavier material consisting of a silty clay to silt loam. On small, irregular ridges the soil is a medium to coarse sand. Ordinarily there is little variation in texture from the surface downward.

This soil occupies low areas immediately bordering the streams, mainly along the sharp bends in the stream courses. It has its principal development along the Nodaway River. Its total area is small.

Owing to its low position, this type is subject to overflow. Its topography is characteristically billowy. The heavier soils lying farther back from the streams are 2 to 6 feet higher than this type.

The Genesee very fine sandy loam is an alluvial soil. Additional material is deposited over areas of this type by swift currents during times of overflow. Only the coarser particles carried are deposited by such currents, so that these areas are composed mainly of coarser material.

Originally this soil supported a heavy forest growth. A large proportion of the type is now cleared and under cultivation.

Owing to its frequent inundation, little effort is being made to practice systematic crop rotation on this type. Corn is the principal crop grown and produces excellent yields. The soil is well suited to wheat, clover, and alfalfa wherever overflows may be prevented. It is also adapted to the production of vegetables, particularly melons, and small fruits.

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

Mechanical analyses of Genesee very fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
343013	Soil.....	0.0	2.1	12.0	27.5	15.5	30.6	12.2
343014.....	Subsoil.....	.0	.4	2.8	11.4	19.7	54.2	11.3

SUMMARY.

Nodaway County is situated in the northwestern corner of Missouri. It has an area of 879 square miles, or 562,560 acres. The county comprises three general physiographic divisions—the upland division, which is by far the most extensive, the terraces, and the bottom lands. It occupies a rolling prairie region and the topography ranges from nearly level to rough and broken. The general slope of the county is toward the south.

The Nodaway, One Hundred and Two, and Platte Rivers with their numerous tributaries carry the drainage.

The county was first settled in 1839. It was organized in 1845. The population of Nodaway County is reported in the 1910 census as 28,833. Maryville, the county seat, with a population of 4,762, is the largest town in the county. Burlington Junction and Hopkins each have a population of about 1,000. Numerous smaller towns are distributed throughout the county.

The transportation facilities in Nodaway County are good, railroads connecting it directly with such markets as Chicago, St. Louis, Kansas City, and Omaha.

The wagon roads are of dirt construction, but are kept in good condition throughout the greater part of the year.

The climate is marked by extremes in temperature and precipitation. The nature of the soils of the county is such that crops withstand periods of drought and of excessive rainfall remarkably well. The mean annual temperature is about 50° F. The annual precipitation averages about 37 inches. There is a normal growing season of about 170 days.

Agriculture is the principal industry of Nodaway County. It consists mainly of general farming combined with stock raising.

Corn is the principal crop grown and occupies an acreage far greater than that devoted to any other crop. Wheat is becoming important as a cash crop. Oats are grown extensively for home use. Rye and barley are common. Clover, alfalfa, timothy, bluegrass, and cowpeas produce profitable yields. Apples are produced on a commercial basis. Small fruits and vegetables do well, being grown extensively for home use.

Only a small total area in this county is unsuited to agriculture. The land of more uneven topography is used for pasture.

The live-stock industry is important throughout the county. The greater part of the grain crop is used for feeding stock.

Dairying and poultry production are practiced to some extent, and constitute profitable branches of agriculture.

The value of farm land ranges from about \$50 to \$200 an acre, the average value being given in the 1910 census as about \$80.

Farm labor usually is scarce.

The appearance of the farms and the farm buildings throughout the county indicates a general condition of prosperity.

Ten distinct soil types are recognized in Nodaway County. These fall into two general groups—the upland soils, which are by far the most extensive, and the bottom-land soils. On the basis of their origin the upland soils are divided into two general classes, glacial soils and loessial soils. The bottom-land soils are also divided into two general groups—terraces and the first-bottom soils.

The glacial soils of the uplands are derived from a deposit known as the Kansan drift. They comprise three series—the Shelby, Miami, and Carrington. Of these the Shelby and Miami, each represented by one member, are the most extensive, being the predominating soils of the eastern part of the county. The Shelby loam occupies steep slopes and broken areas. It is a light-colored soil which is subject to destructive erosion. Crops on this type suffer from drought. The Miami silt loam occupies the crests of high, narrow ridges. It is a soil of low productiveness and is best suited to the growing of blue-grass. The Carrington series is also represented by only one type, the silt loam. This soil occupies the more gentle slopes, mainly in the central and eastern part of the county. It is a dark-colored productive soil, but crops sometimes suffer from prolonged droughts.

The loessial soils of the uplands are derived from wind-blown material deposited over glacial drift. They comprise the Marshall series, of which two types are recognized. The Marshall silty clay loam is not extensively developed. It is very productive, but subject to destructive erosion. The Marshall silt loam is the most extensive type in the county, predominating in the western section. It is highly productive.

Of the bottom-land soils, the material which occupies the terraces is classed in the Bremer series. Only one type of this series is recognized—the Bremer silt loam. This is a strong, productive, easily handled soil.

The first-bottom soils are included in two series—the Wabash, represented by three types, and the Genesee, of which one member is recognized. The Wabash silt loam is the most elevated and best

drained soil of its series. It is a productive and easily cultivated soil. A colluvial phase of this type is mapped along the smaller streams and as overwash along the river bottoms. The Wabash silty clay loam is a low-lying soil developed mainly along the rivers. It is a productive, drought-resistant soil but difficult to handle, and crops are injured during seasons of abnormal rainfall. The clay is much like the silty clay loam in crop value and conditions. With drainage it is a strong, productive soil.

The Genesee very fine sandy loam occurs in small, irregular, low-lying areas bordering the rivers. It is a light-brown, productive soil and is easily tilled, but is subject to overflow.

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