

# SOIL SURVEY OF CASS COUNTY, NEBRASKA.

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## DESCRIPTION OF THE AREA.

Cass County is located in the extreme eastern part of Nebraska, immediately south of the Platte River. It is bounded on the north by Saunders County and the Platte River, which separates it from Sarpy County; on the east by the Missouri River, which forms the State line; on the south by Otoe County, and on the west by Lancaster County. From north to south the county is about 19 miles

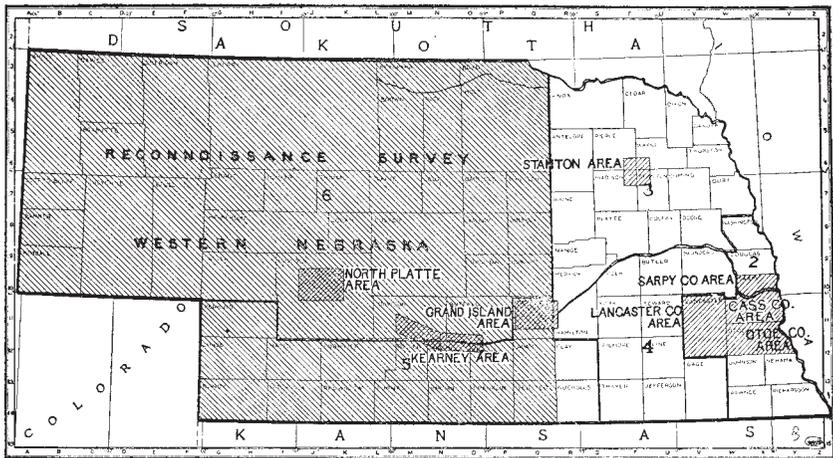


FIG. 52.—Sketch map showing areas surveyed in Nebraska.

wide, and its greatest length from east to west is 33 miles. It forms an irregular rectangle, and comprises an area of 552 square miles, or 353,280 acres. The western boundary of the county is about 15 miles from Lincoln, the state capital. The northern boundary is about 15 miles south of Omaha, the metropolis of the State.

Cass County comprises three general topographic divisions—the uplands, the terraces, and the river bottoms.

The uplands are covered by a superficial deposit of drift and loess. For the most part the surface is smooth to gently rolling, but along the borders of the valleys large areas of more or less broken country

have been developed by erosion. The more nearly level part of the upland is encountered on the broad divides between the several drainage ways. One of the most prominent divides extends from a point 6 miles southeast of Alvo northwestward, and, passing Alvo, turns sharply to the northeast, terminating a short distance beyond Murdock. Another crosses Eightmile Grove precinct and extends into Mount Pleasant precinct. In some places these divides are almost level, but more commonly they form gently sloping watersheds. The slopes vary widely in topography. In general, those more remote from the large drainage ways are gentle, while those near the large streams are sharp and precipitous. The character of the mantle rock and bedrock has also influenced the character of the topography along the slopes. The most sharply eroded area is a belt from one-half mile to 3 miles wide, which follows the Platte and the Missouri Rivers along the northern and eastern border of the county. Here the streams have cut sharply down into the soft, silty material, forming deep, V-shaped valleys with sharply dissected slopes. This type of topography changes gradually as the gently rolling upland is approached. In the southern part of the county, in Tipton, Stove Creek, Weeping Water, and Avoca Precincts the topography becomes more steeply rolling, over what is known as the drift hills.

The terraces or benches of Cass County are of alluvial origin, and comprise the higher or second terraces, and the lower or first terraces. The second terraces occur almost entirely along Salt Creek in the northwestern corner of the county, with a small area along Weeping Water Creek about a mile west of Union. In the former location they are rather flat and benchlike, except locally, although slightly dissected by small streams which flow into Salt Creek. Marshy depressions and outcrops of basal material are common. The transition between the benches and the first bottoms is abrupt, the slopes being steep to precipitous, while between the upper terrace and the upland the slopes are gradual. The area west of Union is rather dissected and its topography is comparable with that of the upland. The lower benches occur along Salt Creek, the Platte and Missouri Rivers, and Weeping Water Creek. The largest area occurs along Salt Creek, about 2 miles northwest of Greenwood, and the other areas are very small and are scattered along the stream courses.

The first bottoms in Cass County are relatively inextensive, comprising about one-thirteenth of the area of the county. Since the Platte River encounters the hard Pennsylvanian rocks along the northern border of the county and the Missouri River hugs the right bluff line, there is but little bottom land along these streams. A number of areas occur along Salt Creek and Weeping Water Creek. The slopes between the first bottoms and the upland along the Platte and Missouri Rivers and along Weeping Water Creek about a mile

below Wabash are, as a rule, very steep to precipitous. The surface of the bottom lands is generally flat. The topography is slightly relieved by such minor features as depressions, ox-bow lakes, cut-offs, old channels, overflow channels, and intervening sand ridges. The elevation of the bottom land ranges from 1,060 feet above sea level in the northwestern part of the county to 928 feet in the southeastern corner. The highest point in the county, 1,360 feet above sea level, occurs immediately west of Eagle. Thus the total range in elevation for the entire county is less than 440 feet.

Cass County is drained by five important streams, the Platte and Missouri Rivers, Salt and Weeping Water Creeks, and the headwaters of Little Nemaha River. The Platte River forms the greater part of the northern boundary of the county, and, with its tributaries, drains about 130 square miles in the northern section. The Platte River is a broad, shallow, overloaded stream and is characterized by numerous sand bars and low, sandy islands. The Missouri River flows almost due south along the eastern border of the county and drains a narrow area of about 45 square miles. Salt Creek and its tributaries drain an area of about 87 square miles, and Weeping Water Creek about 246 square miles. The general direction of the drainage in Cass County is southeast, though most of the branches of the Platte River flow in a northeasterly direction. In general the county is well drained.

The first settlement in Cass County was made in 1853 at a point just below the mouth of the Platte River. The land bordering the west banks of the Missouri River was settled immediately on the termination of the titles of the Indians who originally held it in 1854, although it was not until 1856 that settlement was extended to the western border of the county. The county was organized in 1855. The first settlers were mainly from Iowa, Missouri, Illinois, Indiana, Ohio, Vermont, and other eastern States. Subsequently a number of Germans, Swedes, and Irish settled in the county.

The population of Cass County, according to the United States census reports, increased until about 1890. Since that time it has steadily decreased. The 1890 census reports a population of 24,080. In 1900 the population is reported as 21,330, and in 1910 as 19,786.

Plattsmouth, the county seat, with a population of about 4,300, is situated in the extreme northeastern corner of the county, below the mouth of the Platte River. Two grain elevators, a flour mill, broom, basket, brick, cement-block, and glove factories, and railroad shops are located in this town, and it is an important distributing point for agricultural implements and supplies. Weeping Water, the second largest town in the county, is located in the south-central section. It has a population of about 1,100. This town has a grain elevator and

a flour mill. Louisville, an incorporated town with a population of about 800, is located in the northern part of the county on the Platte River. It is noted for its several stone quarries and clay and sand pits, and has two grain elevators. Greenwood is an incorporated village, located in the northwestern corner of the county. It has a population of about 400. A number of smaller towns and railroad points of local importance are scattered throughout the county.

Cass County is well supplied with railroads, no point within the county being more than 8 miles from a railroad station. Lines of the Chicago, Burlington & Quincy, the Chicago, Rock Island & Pacific Railway, and the Missouri Pacific cross the county.

The Ashland and Louisville routes of the Omaha, Lincoln & Denver Highway traverse the northwestern part of the county. They meet at Greenwood. The main public roads are usually kept in good condition, though very little attention is given to the less important roads. Practically all are dirt roads and follow section lines. The main roads are dragged as soon after each rain as the ground permits in order to keep them in smooth condition. There are two wagon bridges across the Platte River, at Louisville and Oreapolis, and a ferry is operated on the Missouri River at Fremont Point, southeast of Plattsmouth. There are no toll roads in the county, but toll is charged at the Platte River bridges and at the ferry.

Owing to the existence of direct railroad lines between the county and Omaha and Lincoln, the market facilities are good. There is a demand in Omaha and South Omaha for practically all of the farm products, and both Omaha and Lincoln are good markets for dairy products.

All parts of the county are supplied with the rural free delivery of mail, and telephones are in general use.

#### CLIMATE.

The data in the table below are compiled from the records of the Weather Bureau station at Lincoln, Lancaster County, which has about the same elevation and latitude as Cass County and may be taken as fairly representative of the local climatic conditions. The table also gives the normal monthly, seasonal, and annual precipitation as recorded at the station at Weeping Water, but no temperature data are available for this station.

*Normal monthly, seasonal, and annual temperature and precipitation.*

Month.	Lincoln.						Weeping Water, precipitation.		
	Temperature.			Precipitation.			Mean	Total amount for the driest year.	Total amount for the wettest year.
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.			
	°F.	°F.	°F.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
December.....	29.6	71	-18	0.70	0.32	1.96	0.81	0.09	0.00
January.....	22.6	66	-29	.66	.86	1.02	.88	.71	.75
February.....	23.7	79	-26	.95	.06	.14	.98	.67	.75
Winter.....	25.3			2.31	1.24	3.12	2.67	1.47	1.50
March.....	37.2	91	-11	1.23	.72	.37	1.34	1.13	.25
April.....	51.3	95	17	2.60	.33	.67	2.56	3.34	.75
May.....	61.8	98	26	4.49	3.43	3.65	4.21	.94	6.75
Spring.....	50.1			8.32	4.48	4.69	8.11	5.41	7.75
June.....	71.2	103	43	4.61	3.14	8.83	5.12	6.81	14.62
July.....	75.8	106	49	4.31	1.72	11.35	4.07	2.32	1.88
August.....	74.8	102	43	3.48	1.84	4.35	3.99	3.04	11.50
Summer.....	73.9			12.40	6.70	24.53	13.18	12.17	28.00
September.....	66.6	101	27	2.53	.98	4.10	2.91	.79	2.25
October.....	54.8	92	15	2.08	1.11	2.81	2.34	.11	6.00
November.....	39.2	80	-15	.79	.61	1.97	1.09	1.11	.50
Fall.....	53.5			5.40	2.70	8.88	6.34	2.01	8.75
Year.....	50.7	106	-29	28.43	15.12	41.22	30.30	21.06	46.00

The figures in the table indicate a mean annual temperature of about 51° F. According to the records of the Lincoln station, January and February are the coldest months, with a mean temperature of about 23°, and July is the warmest, with a temperature of about 76°, while the average temperature for August is only 1 degree lower. This gives a range in temperature between the coldest and warmest months of about 53°. The lowest temperature recorded is -29° and the highest 106° F.

The average date of the last killing frost in the spring, according to the records of the Weather Bureau station at Weeping Water, is May 8, and of the first in the fall October 1. The latest date of killing frost in the spring recorded is May 27, and the earliest in the fall September 13. At the Lincoln station the average date of the last killing frost in the spring is April 19, and that of the first in the fall October 10. The latest date of killing frost in the spring recorded at this station is May 7 and the earliest in the fall September 12. The

normal growing season in Cass County is thus long enough for the maturity of all the ordinary farm crops of the general region.

According to the records of the local station, the mean annual precipitation is 30.3 inches, about 2 inches in excess of that recorded at Lincoln. The precipitation is heaviest during the months of May, June, and July. For the summer months, June, July, and August, it averages about 13 inches. It is lightest during the winter, with a mean for December, January, and February of something less than 3 inches.

The greater part of the precipitation in the summer occurs as local storms. The rainfall during May and June is well distributed, periods of drought being practically unknown. In July the distribution is less favorable, and during August and September the rainfall is much lighter, so that long periods of drought occur occasionally during these three months. In general, there is sufficient rainfall during the growing season to prevent serious injury to crops where the moisture is properly conserved, and total crop failures do not occur, although the corn crop sometimes is injured by drought and hot winds.

According to the records at Lincoln the snowfall averages about 23 inches annually. This occurs mainly during December, January, February, and March.

The winds are prevailing from the northwest. During June, July, and August the wind is mainly from the south or southeast. The direction changes frequently throughout the year. At Lincoln the wind has an average velocity of about 11 miles per hour. Tornadoes are rare.

The Lincoln records also show the relative humidity to be comparatively uniform. The average annual is about 70 per cent. The same records show an average of 175 to 185 clear days and 81 to 86 cloudy days, the remaining days in the year being partly cloudy.

Under the existing climatic conditions the general farm crops—corn, wheat, etc.—are successfully grown.

#### AGRICULTURE.

The early settlers in Cass County directed their attention mainly to the production of such crops as were required to supply home needs, including corn, potatoes, garden vegetables, etc. Corn was grown only for home use, the climate being considered too dry for its successful production on a large scale. Wheat soon became the important cash crop of the region, but from 1870 corn production gained in importance, and by 1880 had become the leading crop of the county, although the acreage of wheat was still large. The census of that year reports 97,901 acres in corn, with a yield of

4,312,032 bushels, and 39,443 acres in wheat, producing 394,701 bushels. Oats and barley were also grown to some extent, 8,907 acres of the former yielding 228,877 bushels, and 7,810 acres of the latter 108,631 bushels. The production of flax was attempted between 1870 and 1880, but this crop was soon abandoned. Some rye was grown in the county, a production of 17,759 bushels from 1,216 acres being reported in 1880. A few patches of tobacco were grown prior to 1880, and a small quantity of sweet potatoes was produced. Buckwheat was also grown to a small extent. Wild hay was cut from 12,568 acres in 1879, and 21,688 tons of hay were produced. About 1880 the growing of broom corn attained some importance, particularly in the vicinity of Alvo. Owing to the difficulty of securing cheap labor, however, this crop did not prove profitable and was soon discontinued.

The present agriculture of Cass County consists mainly of grain production, though considerable attention is given to dairying and the raising of hogs and other live stock. Corn, wheat, oats, wild grasses, alfalfa, and clover are the chief crops, ranking in the order in which they are named. The type of farming practiced is uniform throughout the county, except that the relative importance of the various crops differs in different sections. The present tendency is to produce less corn, more wheat, about the same amount of oats, and more alfalfa.

Corn is by far the most important crop in Cass County, and a little more than three-sevenths of the total area of improved farm land is devoted to it. It is grown on all the soil types of the county, but does best on the silt loams. A production of 3,395,424 bushels from a total of 133,650 acres is reported in the 1910 census. The average yield for the county is about 25 bushels per acre. The acreage devoted to corn has decreased considerably since 1900, the acreage of wheat, hay, and alfalfa being increased. Leaming Improved, Reids Yellow Dent, and Iowa Silver Mine are the varieties of corn most largely planted. Corn is generally listed, though some is check rowed and a small acreage is double listed.

The greater part of the corn is sold, although a large part of the crop is fed to hogs and beef cattle. On farms with silos the corn is largely cut for silage; in other cases only the grain and the finer parts of the plant are used for feed. Ordinary field corn is used for silage, but it is planted thicker. It is a general practice where the corn is not cut for silage to pasture the fields after the ears have been removed.

On many farms corn is grown from 4 to 5 years in succession, and in some cases it has been grown continuously for 20 years or more. Best results are had where this crop is grown in a systematic rotation with small grains and leguminous crops.

Wheat is second in acreage to the corn crop in the county. The 1910 census reports a total of 36,292 acres in wheat, with a production of 715,633 bushels. Immediately after 1880, owing to poor yields, spring wheat began to decline in importance, corn being found a more profitable crop. At present the Turkey Red variety is grown almost exclusively. This has almost entirely taken the place of the spring varieties, because it produces better yields, can be sowed in the fall when it does not interfere with the work of caring for other crops, and withstands drought better, as it matures before the dry weather and hot winds occur. It is grown profitably on all the soil types farmed, except the Knox silt loam and the Lancaster fine sandy loam, which are too steeply rolling. As a rule wheat is grown in the same fields from two to four years in succession, following oats. Where corn is cut for silage wheat is grown after this crop with excellent results. Wheat is strictly a cash crop and is usually sold direct from the thrashing machine.

The acreage of oats has decreased slightly within the last decade. At present a little more than one-tenth of the total improved acreage in farms is devoted to the production of this crop. The 1910 census reports a total of 31,452 acres in oats, with a yield of 700,892 bushels. This crop does well on all the soils except the bottom-land types, on which it is likely to lodge. The Kherson, a very short, stiff-strawed variety, has given the best results in the bottom lands. This is a less profitable crop than either corn or wheat, which in many cases displace it in the rotation. It is generally found impracticable to follow corn with winter wheat, and as a rule oats occupy this place in the rotation. Oats are seldom sown for more than one year in succession. The greater part of the crop is fed to horses and other live stock, although a part of it is sold.

The acreage of wild hay is not very large, being confined to the bottom land of the county. Most of the wild hay is grown in the Salt Creek, Weeping Water Creek, and Platte River bottoms, with a small acreage on the Missouri River bottoms. Only a few acres of upland remain in virgin prairie. Within the last few years a large total area of land has been reclaimed by ditching and tiling, and the acreage of wild hay has been considerably reduced. It is probable that most of the virgin hay land, except the lower areas along the Platte River, will eventually be broken and devoted to the production of farm crops. According to the 1910 census, 14,784 tons of hay were cut from 10,259 acres in wild grasses in 1909. Most of the hay is stacked in the fields, and as soon as time permits, if sold, it is baled and hauled to market. Where kept for feed it is used from the stacks as needed. A number of the upland farmers own hay lots in the bottom lands. In such cases the hay is mainly fed to live stock.

Alfalfa has become a valuable crop in Cass County. In 1910 a total of 1,829 acres was reported as compared with the 212 acres reported in 1900, showing a decided gain in favor. The yield was 5,071 tons. The crop does well on the upland and on well-drained bottom-land soils. Three cuttings and sometimes four are obtained each year, with a total yield ranging from 3 to 5 tons per acre. Alfalfa is chiefly grown on the Knox, Marshall, and Shelby silt loams. Most of the alfalfa is fed as hay to cattle and horses, though some is used as pasturage for hogs. It is usually sown after wheat, and the stand maintained from 5 to 7 years. This crop requires a good seed bed and does best where it is sowed immediately after the first rain in August. Fifteen pounds of seed per acre is considered sufficient to insure a good stand.

Very little clover is grown in the county, owing to the difficulty of starting the crop. As a rule the rainfall between the middle of July and the middle of September is not great enough to enable the delicate clover plants to withstand the extremely hot winds and occasional long droughts which occur after the nurse crop has been removed. If the rainfall is ample at the time it is most needed, immediately after the cutting of the grain crop, clover does well, yielding from  $1\frac{1}{2}$  to  $2\frac{1}{2}$  tons per acre. The 1910 census reports 1,561 acres in clover, with a production of 2,271 tons of hay. During the last few years, however, the crop has failed almost entirely. As a rule, clover and timothy are sown together in the proportion of 1 to 2. A small acreage is devoted to millet and Hungarian grasses and to other tame grasses. The census of 1910 reports 167 acres in millet and Hungarian grasses, producing 318 tons of hay, and 305 acres in other tame grasses, with a yield of 418 tons of hay.

Some sorghum and kafir are grown, the former largely for sirup, although a part of the crop is fed to stock. Kafir does well and is used as feed for stock.

Some vegetables are grown on a commercial scale near the towns and villages of the county, but the trucking industry is in general given but little attention. The farmers generally grow potatoes, but seldom have a surplus, and the majority buy potatoes each year. The potato patch is usually neglected and as a result the yield is low. According to the census of 1910, 1,305 acres were devoted to this crop in 1909, with a yield of 112,103 bushels. A total area of 526 acres is reported in other vegetables.

There are a number of commercial fruit orchards in Cass County. The largest are found in the vicinity of Nehawka and along the bluff zone of the Missouri River. The Shelby silt loam, the Marshall silt loam, and the Knox silt loam are used for this purpose. In addition, small farm orchards are found throughout the county. The preferred locations are the north slopes along the bluff zone of the

Platte and Missouri Rivers and along minor streams. With proper attention the production of orchard fruits has been profitable. On favorable sites the upland soils produce apples of good keeping quality, and of good flavor, but of inferior color.

Apples are sorted and only the best fruit marketed, the culls being used largely in the manufacture of cider and vinegar at Nehawka. A large part of the apple crop is shipped to Lincoln, Omaha, and out-of-state markets. In the commercial orchards the Oldenburg and Maiden Blush as summer apples and the Jonathan, York Imperial, Stark, Minkler, Winesap, Grimes Golden, Arkansas, and Ben Davis as winter apples are the varieties which give best results. For the farm orchards the Grimes Golden, Early Harvest, Wealthy, Maiden Blush, Jonathan, Minkler, and Arkansas are popular varieties. There are a few vineyards in the county and where the slope and air circulation are favorable these give profitable returns. In the vicinity of Plattsmouth some small fruit is grown. There is an excellent opportunity in the extension of the orchard industry, and conditions are favorable for the growing of fruits and small fruits for home use on all the farms of the county. The value of all orchard products, including small fruits and nuts, is given in the 1910 census as \$94,651.

Although dairying is now incidental to the production of grain in Cass County, the dairy industry is steadily becoming more important. There is scarcely any pure-bred dairy stock in the county, although the graded Holstein is coming into favor. Most of the farmers keep scrub dairy cows of Shorthorn breeding. The number of dairy cows on the farm varies widely. The average is about six cows per farm. Some farmers merely keep enough to supply the home demand with dairy products, while others sell small quantities of milk. Most of the farmers separate the milk at home. The surplus cream is either shipped to Omaha or Lincoln, or sold at local markets. A few farmers ship milk to Omaha. The cream or milk is shipped either by the producer direct or by the creamery station. The former method is usually more profitable. Very little attention is given to breeding, housing, ventilation, and the proper feeding of cattle on the average farm. There are only a few silos in the county, but the number is gradually increasing.

Beef production has never had an important place in the agriculture of Cass County. There are only a few large herds of beef cattle, mainly on the poorly drained areas of bottom land. A few farmers feed some cattle, obtained from stockyards, with good returns. In general, a few head of beef cattle are fattened on the farms of the county each year, and sold when the prices are favorable. Most of the cattle are Shorthorns, though there are a number of herds of other breeds.

More attention seems to be paid to the breeding of farm and draft horses than to that of any other live stock. Nearly every farmer raises one or two colts each year, and in this way supplies his own work horses and frequently has a team to sell. The Percheron is the favorite breed, though a number of Clydesdales are kept. There are a few flocks of sheep in the county and a small number of mules.

The raising of hogs is the most important branch of the live-stock industry. On an average 30 to 50 hogs per farm are fattened each year for market, in addition to those slaughtered for home use. On a few farms all the corn grown is fed to hogs, and as a rule this practice is profitable. The Duroc Jersey, Poland China, and Chester White are the chief breeds. Very few of the herds are pure bred.

The value of all live stock in Cass County is given in the 1910 census as \$2,827,863.

From 40 to 150 chickens are kept on practically every farm in the county. These are mainly Leghorns, Rhode Island Reds, Plymouth Rocks, Orpingtons, and Wyandottes. On many farms a small number of ducks and geese are raised. With the present high price of eggs and of dressed poultry, the industry is very profitable. The value of poultry of all kinds in Cass County is reported as \$71,698 in the 1910 census.

During the early history of the county the methods of farming were very crude and wasteful. No attention was given to the proper cultivation of crops, seed selection, crop rotation, and fertilization. Owing to poor management the soil became less productive and crop yields decreased. When the cause of the reduction in yields became apparent the methods of farming were gradually improved. At present the farmers give more attention to crop rotation, exercise considerable care in the selection of seed, and sow alfalfa and other legumes to increase the nitrogen content of the soils.

The adaptation of the various crops grown to the different soils of the county is not generally recognized, although this subject is receiving increasing attention. Practically all of the general farm crops common to the region are grown upon most of the soil types in the county. Corn does well on the silt loams and heavier types, but no effort is made to determine whether any crops other than corn, oats, and wheat might be profitably grown on such soils. The lighter soils of the county are best adapted to trucking and the growing of special crops.

The systematic rotation of crops is practiced by only a few more progressive farmers. The general tendency is to grow corn from 2 to 4 years, then oats for 1 year, and to follow the oats with wheat for 2 years. Occasionally the wheat land is seeded to clover and timothy for 2 years and then returned to corn. Fields in which corn or wheat has been grown for 15 years in succession or even longer are not

uncommon. Of late alfalfa has been quite extensively introduced, displacing clover and timothy in the rotation. One of the better rotations practiced in the county consists of corn for 2 years, oats 1 year, wheat 1 to 2 years, and clover and timothy 2 to 3 years. On farms where there is no permanent pasture the clover and timothy is usually pastured the last year.

Very little attention is given to the proper cultivation and fertilization of most of the crops of the county. The heavier soils are particularly in need of more careful cultivation. The plowing under of green crops is not practiced, and commercial fertilizers are not used to any extent. In the census of 1910 the expenditure for commercial fertilizers is reported as \$343.

With few exceptions the farm improvements in Cass County are unusually good. The farm buildings, especially the houses, are painted and kept in good repair. The appearance of the farm homes indicates a condition of general thrift and prosperity. Most of the fences are of barbed wire, although woven wire is also used, and there are numerous hedge fences along the farm lines. The stunting of crops on either side of these hedges makes them undesirable. Within 10 to 15 feet of the hedge the crops are usually a failure. As a rule the farm machinery is not properly housed and cared for.

Farm labor is rather scarce, especially during the harvest season. Laborers usually receive \$25 a month, with board. Most of the laborers are hired from April 1 to December 1, though there is a tendency on the part of the farmers to engage labor for the entire year, in order to secure more efficient help. During harvest time transient laborers are paid from \$2 to \$3 per day with board. Most of the farm work, however, is done by the family, the children and women sometimes working in the fields. An expenditure of \$190,504 for labor is reported for the county in the 1910 census.

There are 339,832 acres in farms in Cass County, according to the census of 1910, of which 308,097 acres are improved. The average size of the farms is given as 156 acres, which is approximately the average for eastern Nebraska. Since 1880 the size of the farms has increased steadily. Only a little over one-half of the farms are operated by the owners, the remainder being occupied largely by tenants.

Both the cash and share system and a combination of the two are practiced in renting the farms. The share system is probably most common. Cash rents vary from \$3 to \$6 an acre for general farming land, depending on the nature of the soil. Under the share system the owner receives two-fifths of the crops grown and all implements and stock are furnished by the tenant. Where land is rented on the basis of an equal division of the crops the owner furnishes the implements and work stock. In the combination system of cash and share

renting the permanent pasture and land not used for crops is rented for cash and the grain and hay land on shares. In any system of renting the tenant is required to deliver the grain to the elevator. Farm values in the county range from \$30 to \$200 per acre, depending on the character of the soil, improvements, and location.

#### SOILS.

The soils of Cass County vary widely both in character of material and in manner of formation. With respect to physiographic position they may be divided into three groups—the upland, alluvial terraces, and first-bottom soils. The upland group embraces the Knox, Marshall, Shelby, and Lancaster series; the alluvial terrace soils are classed with the Waukeshah, Sioux, and Scott series; and the first bottoms comprise the Sarpy, Wabash, and Cass series, and Riverwash. In texture the majority of the upland and terrace soils are silty, while those of the bottom lands vary from a loose, incoherent sand to a heavy clay. With the exception of the Knox and Lancaster, and the recently deposited soils along the Platte and Missouri Rivers, the soils of the county are dark in color and rather high in organic matter.

The upland was originally covered with a very thick mantle of the silty material forming the loess plains, but through erosion the deposit has been practically worn away, and but few remnants of the original covering are left. The most typical remnant is found at Murdock and Alvo, with a few smaller ones northwest of Weeping Water, and one west of Plattsmouth. Where fairly typical this deposit is mapped as a flat phase of the Marshall silt loam. In areas where erosion has removed a large part of the original loess mantle, but the remnant still retains loess characteristics, the soils weathered from it are classed with the Marshall series. Along the bluff line of the Platte and Missouri Rivers the loess has been modified by material blown over it from the sand and silt bars of the streams. This comparatively new material and the badly eroded loess of older age are classed as the Knox silt loam, and to a small extent as the Marshall silt loam. The more recently formed loess beds vary in color from yellow or pale yellow to light gray, showing iron stains, and contain more or less lime.

Below the loess plains material lies the weathered phase of the Kansan drift, which gives rise to the Shelby silt loam. The loess and the weathered phase of the Kansan drift are so very similar in character that it is necessary to point out the fine distinctions between the two. The weathered phase of the drift is a yellowish or pale-yellow to light gray, smooth silty layer, with numerous lime concretions and iron stains. It has a vertical structure, and is prac-

tically stone free, although it contains a few large sand grains and small cobblestones. The soil derived from the weathered phase is heavy in texture, breaks into granules, and does not stand in vertical layers nearly as well as the soils derived from the true loess. In the fourth foot of the subsoil there is no apparent difference between the two formations, except that there are a few stones in the drift. There is no definite line of separation between the loess and the weathered drift, but they grade imperceptibly into each other. As a result, there are large areas of loesslike material, which possess the characteristics of both the loess which weathers into the Marshall silt loam, and the drift which gives rise to the Shelby silt loam, occurring in the southern and southwestern parts of the county. Here a separation of the two is difficult.

Below the weathered phase of the Kansan drift lies the Kansan drift proper. There is a sharp line of demarcation in color and texture between these two divisions. The upper part of the Kansan drift is thoroughly oxidized, showing that it has been subjected to weathering. Undoubtedly the weathered phase has been altered so much by wind action that it has lost its drift characteristics, and it has the appearance of the loess. The Kansan sheet is unmistakably till and consists of a heterogeneous mixture of clay, silt, sand, cobblestones, and boulders. The upper oxidized zone varies in color from yellowish brown or brown to reddish brown. Below this the drift sheet has a light-gray or pale-yellow color, with numerous iron stains. Material of this drift sheet gives rise to the Shelby loam.

The Aftonian material lies below the Kansan drift and consists largely of stratified sands and gravel with a few boulders. It crops out in a number of places throughout the county and in Sec. 14 T. 12 N., R. 9 E., it gives rise to local areas of fine sandy loam, mapped as the Lancaster fine sandy loam.

The lowest drift sheet, the Nebraskan, consists of a blue clay containing numerous small pebbles but fewer boulders than the Kansan. It is exposed only in deep-cut banks. This drift sheet rests on the Dakota formation in the western and northern sections and on the Pennsylvanian beds of the Carboniferous age over the remainder of the county. There are numerous outcrops of the Dakota formation in the northern and northwestern part of the county. It consists of rust-colored sandstone, clay, shale, and gravel. Locally this formation gives rise to the Lancaster fine sandy loam, though the surface soil has apparently been modified considerably by glacial material. South of Louisville sandstone which is used for building purposes is derived from the Dakota formation, while between Louisville and Cedar Creek, and between Cedar Creek and Cullom, gravel is produced. Southwest and east of Louisville this formation is a source of clay,

which is hauled to Omaha, where it is mixed with loess and drift and made into brick and tile.

The Pennsylvanian system consists of limestones and shales. The limestones of the Pennsylvanian are extensively quarried at Nehawka, west and southwest of Weeping Water, and in the vicinity of Louisville and Cedar Creek, and have been quarried at Cullom and Plattsmouth. The shales are suitable for making brick.

Along the streams of Cass County are found two series of terraces or benches. The elevation of this second terrace corresponds with that of Todd Valley in Saunders County, and is of later age than the loess plains. The first terrace is of still more recent origin. The terraces or benches consist of loess to depths of 10 to 30 feet, the average being 15 feet. Along Salt Creek and the Platte and Missouri Rivers the basal material consists of light-gray sand and gravel laid down by streams flowing at a high level and, along the smaller streams, of unsorted glacial débris. Whether the benches along Salt Creek are uniformly underlain by stratified sands is not known. The loess covering gives rise to the Waukesha silt loam and the Scott silt loam, where the basal material is sand. The Sioux fine sandy loam is derived from the basal material, which is more or less modified by wind action.

The stream alluvium or first-bottom soils of Cass County are of quite recent origin, and in many cases are still in process of formation. Along the smaller streams the alluvium consists largely of stratified clays and silts, owing to the prevailing fine texture of soils from which the material is washed, though locally coarser material from the Kansan drift is present. Along the Platte River the deposits consist largely of alternate layers of stratified medium and coarse sand and gravel, with a few seams of fine sand, silt, and clay in the upper portion, while the alluvium of the Missouri River is composed largely of alternate layers of very fine sand, silt, and clay. The alluvial deposits along the smaller streams are shallow compared with those along the Missouri and Platte Rivers, where they vary from 60 to 100 feet in depth. The first bottoms in the upland and second-terrace regions are classed with the Wabash series, and those along the Platte and Missouri Rivers largely with the Sarpy series, and to a small extent with the Cass and Wabash series and Riverwash.

The following table gives the names and extent of the various soils mapped in Cass County:

*Areas of different soils.*

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Marshall silt loam.....	176,640	50.5	Sarpy silt loam.....	768	0.2
Flat phase.....	1,728		Cass silt loam.....	704	.2
Shelby silt loam.....	81,344	23.0	Wabash clay.....	512	.1
Wabash silt loam.....	39,808	11.6	Cass clay.....	320	.1
Colluvial phase.....	1,664		Sarpy fine sand.....	320	.1
Knox silt loam.....	32,576	9.2	Lancaster fine sandy loam....	192	.1
Waukesha silt loam.....	7,104	2.0	Scott silt loam.....	64	.1
Shelby loam.....	4,224	1.2	Sioux fine sandy loam.....	64	.1
Cass fine sandy loam.....	2,624	.7	Cass very fine sandy loam....	64	.1
Sarpy very fine sandy loam...	1,344	.4			
Riverwash.....	1,216	.3	Total.....	353,280	.....

MARSHALL SERIES.

The Marshall soils are dark brown to black. This series includes the dark-colored upland loessial soils which predominate in the great prairie region of the Central West. The soils are characterized and distinguished from those of the Knox series by the large quantity of organic matter in the surface soil. The topography is level to rolling and artificial drainage is generally necessary to secure the best results with crops.

MARSHALL SILT LOAM.

The Marshall silt loam is a moderately heavy silt loam which is dark brown or dark grayish brown when dry. This material averages 12 to 15 inches in depth and is underlain by a brown or brownish-yellow very heavy silt loam. At 20 to 24 inches a yellow very compact silty clay loam is encountered. A yellow, mottled with light gray, silty clay loam occurs at depths of 30 to 36 inches, although the yellow color frequently extends to 36 or 40 inches. Between 32 and 40 inches from the surface the subsoil is looser and has the character of a silt loam. There is a concentration of clay between 2 and 4 feet resulting from the washing down of clay particles. The subsoil is highly calcareous, the lime being chiefly in the form of concretions of varying size. Between 3 and 4 feet the material is faintly marked with yellowish, rusty-brown, or brownish iron stains, and these become very pronounced at greater depths. A high percentage of organic matter gives this soil its characteristic dark color.

The depth of the soil is variable, and depends upon its topographic position. In comparatively flat areas it is usually 15 to 18 inches deep, while on the sharp divides, shoulders of hills, and along gullies it has a depth of only 6 to 8 inches, and the yellowish-brown subsoil is frequently exposed. On the lower slopes the soil is deeper and darker

in color, and at the foot of the slopes commonly extends to depths of 24 to 40 inches. The color of the subsoil varies from brownish yellow, yellow, and pale yellow to yellowish gray. Along intermittent streams this type includes small, narrow strips of colluvial material which are too small to be shown separately on the soil map. It also includes, along the shoulders of hills and in small gullies, patches of Knox silt loam. These areas occur mainly along the break of the upland following Weeping Water Creek, below Weeping Water, and along the border of the Knox silt loam.

Along Weeping Water Creek and its branches the bedrock is generally near the surface and in many places it is exposed along the edge of drainage ways. This condition produces a rough stony phase of the Marshall silt loam which is indicated on the map by the conventional rock outcrop symbol. The most extensive variation in the type, however, is developed at Mynard, where the soil apparently occupies a rather dissected bench. Here the type differs from the typical only in having a deeper surface soil. This phase occurs as a low bench, about 15 feet above the first bottoms, along Fourmile and Eightmile Creeks and their branches. The surface in general is rather flat, but in detail it is more or less eroded.

The Marshall silt loam differs from the Knox silt loam in having a darker color, higher organic-matter content, and a smoother topography. Both soils have the vertical structure and extremely smooth feel which are characteristic of loess soils.

This type is the most extensive upland soil in the county, comprising approximately three-fourths of the upland region. In the southwestern part of the county it gives way to the Shelby silt loam, and in the northern and eastern sections to a narrow zone of Knox silt loam. From the southeastern corner it extends into Otoe County and in the western part it reaches through the northwestern corner of Lancaster County into Saunders County, being intercepted by the first bottoms and terraces of Salt Creek, which leave a small isolated area in the extreme northwestern corner of Cass County.

The topography of the Marshall silt loam varies from gently rolling to rolling. The type includes a number of rather wide divides with slight relief between Alvo and Murdock, and in the southern part of Eightmile Grove and the northern part of Mount Pleasant Precincts. In these locations the stream valleys are merely prairie sags and the transition from the first bottoms to the divides is marked by a very gentle slope. In general, along the large streams the slope of the divides is steep to precipitous, while farther back from the streams it is rather gentle. Where the bottom land is skirted by bedrock, the slope between the bottom land and upland is usually almost precipitous.

Erosion is a serious problem on many of the farms on this type. The most effective means of checking the further development of gullies which have started is by building dams of branches or piling straw in them. The steep slopes are best utilized for permanent pasture and the growing of cover crops.

The Marshall silt loam is derived from the eroded loess plains material. Owing to the difficulty of distinguishing between the loess and loesslike drift, it is extremely difficult to draw a satisfactory boundary line between the Shelby silt loam and the Marshall silt loam, and small areas of Marshall silt loam within the Shelby silt loam type, or small areas of the latter within the Marshall silt loam can not be satisfactorily mapped. Large quantities of organic matter are incorporated in the surface soil as a result of the decay of prairie grasses. The type was originally covered with a thick growth of this character, but only a few small scattered patches remain.

Practically all of the Marshall silt loam is under cultivation. It is the dominant corn-producing soil of eastern Nebraska. About one-half of it in this county is devoted to corn, and the remainder is largely in oats, wheat, and alfalfa. The soil is well adapted to corn and yields from 35 to 45 bushels per acre, and in favorable seasons as high as 75 bushels per acre are obtained. Wheat ranks second to corn in acreage. This crop is being more extensively grown each year. It does well on this soil, ordinarily giving yields of 20 to 30 bushels per acre. The acreage of clover, timothy, and alfalfa is very small. In favorable years clover produces from  $1\frac{1}{2}$  to 2 tons of hay per acre. This type is admirably adapted to alfalfa. From 3 to 4 tons of hay per acre are obtained from three or four cuttings. The tendency is to grow less corn and more wheat and leguminous crops and to keep more live stock on the farms of this type.

A crop rotation commonly practiced consists of corn for 2 to 3 years, oats 1 year, and wheat for 1 to 2 years, returning to corn. Occasionally the wheat field is sown to alfalfa, in which case it is usually left in that crop from 5 to 7 years, when it is generally returned to corn. In many cases no definite rotation is practiced, and corn or wheat may be grown on the same land for 4 or 5 years in succession.

This soil is silty, friable, and stone free. It is very easy to handle and can be cultivated under a wide range of moisture conditions.

This type is somewhat more easily cultivated than the Shelby silt loam, owing to the fact that it is lighter in texture, but as a rule 4 horses are used in the heavier operations, like plowing.

Only a small amount of barnyard manure is applied to this type and no commercial fertilizers are used. Owing to its high organic-matter content and silty texture it has the power to resist drought for long periods of time, provided proper attention is given to the conservation of soil moisture.

Under the present system of farming the productiveness of the soil is gradually decreasing, especially on tenant farms.

Farm values on this soil range from \$150 to \$200 an acre, depending upon location, improvements, and the condition of the land.

*Marshall silt loam, flat phase.*—The soil of the Marshall silt loam, flat phase, consists of a dark-brown, moderately heavy, smooth silt loam, which has an average depth of 15 to 18 inches. It is underlain by a yellowish-brown or brownish-yellow, heavier and more compact silt loam to silty clay loam. At 30 inches the color of the subsoil is yellow mottled with light gray. The lower subsoil is slightly stained with yellow iron oxide and is highly calcareous. As the color indicates, the flat phase is high in organic matter.

This phase has a small extent, covering only about 3 square miles. Two areas occur in the vicinity of Murdock, and another immediately south of Alvo. It occupies high divides with only slight relief and has good drainage. The streams have not cut back into these areas, but are near enough to provide adequate drainage. In the area at Murdock a depressed area characteristic of the loess plains, is found. The Marshall silt loam, flat phase, is derived from the loess of the loess plains.

The native growth and the crop adaptation of this type are similar to those of the Marshall silt loam. Owing to its flat topography, it is preferable for farming, and higher yields are obtained.

The value of the Marshall silt loam, flat phase, ranges from \$175 to \$200 an acre.

#### LANCASTER SERIES.

The soils of the Lancaster series are dark brown to brownish gray, and the subsoils yellow to gray. The series has been encountered only in Nebraska, and is residual from sandstone or derived from sand beds of both glacial and eolian origin. The topography is rolling to hilly, and the soils are thoroughly drained and are not retentive of moisture.

#### LANCASTER FINE SANDY LOAM.

The surface soil of the Lancaster fine sandy loam consists of a grayish-brown to brownish-gray fine sandy loam. It has an average depth of 10 inches, and is underlain by a yellow or pale-yellow fine sand which is sticky when moist but rather loose when dry. The type is low in organic matter and is rather leachy. In level areas a few boulders and pebbles are encountered.

This type comprises a total area of only three-tenths square mile. Small areas occur in the northwestern corner of the county, into which the soil extends from Saunders County. A somewhat larger area lies in the vicinity of Louisville.

The topography is steeply sloping, and the soil is thoroughly drained and very unretentive of moisture.

The Lancaster fine sandy loam typically is derived in situ from the Dakota sandstone, though in this county it is derived largely from sands underlying the loess and only locally from the Dakota sandstone. The sand is both of glacial and wind origin.

The native vegetation on the Lancaster fine sandy loam is largely scrub oak.

About 50 per cent of this type is devoted to staple crops and the remainder is largely in permanent pasture. Owing to the fact that it is very unretentive of moisture, the yields of corn, wheat, and oats are very low. In the vicinity of Louisville, there is an opportunity to use this soil for growing small fruits and early vegetables.

As farm land this soil is valued at \$40 to \$100 an acre, depending largely on its closeness to town.

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

*Mechanical analyses of Lancaster fine sandy loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
370901.....	Soil.....	0.3	3.8	12.2	43.1	11.6	18.7	10.3
370902.....	Subsoil.....	.3	4.0	16.9	61.6	11.4	2.8	4.2

#### KNOX SERIES.

The Knox soils are light brown. The greater part of the soil consists of material formerly called Miami silt loam, where this type was derived directly from the loess. The loess deposits giving the Knox series are always thick enough to form the subsoil as well as the surface soil, the deeper lying glacial till being far enough from the surface to have no marked influence on the general character of the soil. These soils occur mainly in the central Prairie States. The topography is gently undulating to rolling, and surface drainage is generally good.

#### KNOX SILT LOAM.

The soil of the Knox silt loam, owing to its dissected topography is rather variable. On the crests of ridges, tops of hills, and upper slopes, it consists of a yellowish-brown or light-brown to brown, smooth silt loam, 6 to 8 inches deep, underlain by a yellow silt loam which is somewhat lighter in color at 24 inches. The subsoil is somewhat more compact than the surface soil. As the color indicates, the surface soil is low in organic matter. The subsoil contains large quantities of lime concretions, and where erosion is severe these

are scattered over the surface. Yellowish and reddish-yellow iron stains are common in the lower subsoil. On the lower slopes and draws there has been an accumulation of soil with a rather high organic-matter content. In such places this type is a dark-brown silt loam, varying in depth from 10 to 30 inches, and underlain by a yellow, more compact and heavier silt loam. The type has a decided open, columnar structure.

Small, local textural variations of more or less importance occur close along the bluff line of the Platte River extending from Cedar Creek into the northwestern part of the county where the soil is a yellow to pale-yellow coarse silt loam to very fine sandy loam, including small spots of sandy loam. In these areas there is no apparent change in color or texture within the 3-foot section. The soil usually occurs along the break of the bluff line on the points of hills or at the heads of gullies. There are numerous rock outcrops, and large quantities of stone fragments are mixed with the soil. These stony areas are indicated on the soil map by the conventional rock outcrop symbol.

The Knox silt loam has a total area of 50.9 square miles in Cass County and occurs in narrow strips varying from about one-half mile to 2 or more miles in width along the Platte and Missouri Rivers. Small outlying areas occur in the Marshall silt loam type.

The topography of the Knox silt loam is more broken and dissected than is typical of this series. The valleys are decidedly V-shaped. Along the bluff line the slopes are very steep and precipitous, especially where they are bordered by a high rock ledge. The outlying areas, and the marginal areas along the Marshall silt loam have a steeply rolling topography. The soil is thoroughly drained and more droughty than the Marshall silt loam. Erosion is very destructive and great care is necessary in cultivation.

This type is derived from silts blown on the upland from Platte and Missouri valleys, and from the eroded plains loess.

Practically all of the Knox silt loam was originally forested. The principal growth on the upper slopes and crests of hills was bur oak and sumac, and on the lower slopes and draws bitter hickory, elm, box elder, and ash, with some black walnut. Approximately 35 per cent of the area still supports a forest growth, though it is slowly being cleared.

Owing to the dissected surface, the growing of staple crops is difficult. This form of agriculture is practiced quite extensively, however, except on the steeper slopes. Corn, oats, wheat, and alfalfa are the chief crops grown. Corn yields from 15 to 25 bushels, oats 20 to 25 bushels, and wheat 15 to 20 bushels per acre. Alfalfa does well on this type and promises to become the dominant crop. An average of 3 tons of alfalfa hay are secured per season from three

cuttings. A large part of this type is in permanent pasture. A small acreage is devoted to apple orcharding. Apples, small fruits, and grapes do well. In the vicinity of Plattsmouth some trucking is carried on.

Owing to its comparatively open structure and desirable texture, this soil is very easy to handle, and can be cultivated under a wide range of moisture conditions. Considerable live stock is kept, and the soil receives liberal applications of barnyard manure. Very little commercial fertilizer is used.

Land values range from \$50 to \$100 an acre on this type, depending upon the topography and location.

#### SHELBY SERIES.

The soils of the Shelby series are yellowish gray or yellowish brown to brown in color; the subsoils yellow, reddish-yellow or light-brown and a tenacious sandy clay in texture. They are derived from the Kansan drift.

Only the loam and silt loam of the series are developed in Cass County.

#### SHELBY LOAM.

The surface soil of the Shelby loam consists of a dark-brown to dark grayish brown loam to silty loam having an average depth of 8 inches. It is underlain by a tenacious, gritty clay, which is brownish yellow or reddish brown, mottled with brown and gray. Below 24 inches the material has about the same texture but a gray color, mottled slightly with brown and yellow. Where the subsoil is looser in structure and has been more thoroughly oxidized it is reddish brown to a depth of about 40 inches. As a rule the subsoil is very compact, and occasionally it is so gravelly as to be impenetrable with the soil auger. The content of organic matter in the soil is moderately large. The subsoil contains much lime, chiefly in the form of concretions. Black iron concretions are abundant in the subsoil. Gravel is scattered over the surface, and a few bowlders are present, though in most of the fields these are not numerous enough to prevent cultivation.

A shallow phase of this type is encountered in Sec. 36, T. 10 N., R. 13 E. and in Sec. 28, Sec. 29, and Sec. 33, T. 11 N., R. 11 E. The bedrock is very close to the surface, and outcrops are common. This phase is too stony to be of value for grain cropping.

The Shelby loam differs from the Shelby silt loam in having a high stone content in the surface soil. The Shelby silt loam is practically stone free. These types also differ in the texture of the soil and especially of the subsoil, which in case of the Shelby loam

is very gritty and compact. The loam type is easily recognized by the reddish tinge in the color of the subsoil.

The Shelby loam occurs in small areas in the southern part of the county, mainly along the slopes of the larger drainage ways. It is usually developed along the steep slopes between the Shelby silt loam on the higher land and the Wabash silt loam in the bottom land. The drainage is thorough, but owing to the large proportion of clay in the subsoil the type retains moisture remarkably well, though not quite so well as the silt loam. Local spots in which seepage water from the lower slope accumulates occur.

The type is subject to destructive erosion, gullies 10 to 15 feet deep with numerous branching laterals being very common.

The type is derived through weathering from the Kansan glacial drift sheet, and is more or less influenced by the original overlying silt layers. The boulders are mainly Sioux quartzite, granite, greenstone, and flint, with some of Dakota sandstone.

The native vegetation of the Shelby loam consists of the prairie grasses common to this region. Along the larger drainage ways the lower slopes were originally forested, mainly with bur oak.

About 40 per cent of this type is under cultivation, and the remainder is largely in permanent pasture and hay land. A small part is still in native prairie grasses. Good yields of the staple crops, including corn, oats, wheat, and alfalfa, are produced. Corn yields 15 to 35 bushels, oats 20 to 30 bushels, wheat 15 to 20 bushels, and alfalfa  $2\frac{1}{2}$  to  $3\frac{1}{2}$  tons per acre. On a few farms sorghum is grown to supply sirup for home use. Not enough potatoes are produced to supply the home demand.

No definite crop rotation is practiced on this type. The general methods are about the same as on the Shelby silt loam.

Owing to the larger amounts of stony material present this soil is somewhat less desirable for farming than the Shelby silt loam. It can not be cultivated under as wide a range of moisture conditions as the silt loam, and if plowed when too wet it clods and bakes. The soil checks and cracks especially in the heavier areas. A heavy farm equipment is required in cultivating this type. Liberal quantities of barnyard manure are applied to this soil once in every five to six years, and no commercial fertilizers are used.

The value of this land, including farm buildings and improvements, varies from \$80 to \$100 an acre.

#### SHELBY SILT LOAM.

The Shelby silt loam consists of a dark-brown or dark grayish brown heavy silt loam 8 to 15 inches deep, underlain by a light-brown or yellowish-brown, compact silty clay, which grades into a more compact silty clay of yellow color mottled slightly with gray.

Between 30 and 40 inches the material becomes looser in structure, and is pale yellow or yellow mottled with light gray, having the character of a smooth silt loam. There is a concentration of clay in the second or third foot of the soil, the clay being carried down from the surface by percolating waters. Where exposed in banks the material shows a granular structure to a depth of 3 feet and below this a vertical flakelike structure. As the color indicates, the soil contains much organic matter. The subsoil is highly calcareous and in the lower part faintly marked and streaked with yellowish and brownish iron stains.

In depth of soil and also in color the type varies considerably. On the rather broad divides the soil is dark brown in color and about 15 inches deep, while on narrow crestlike divides the soil has been largely removed, a brownish or yellowish-brown silty clay being exposed. On the shoulders of hills and along gullies the soil is a medium-brown heavy silt loam, 4 to 6 inches deep. In places the subsoil is exposed, but on the lower slopes the soil is deeper and darker in color. At the foot of the slope the soil is a dark-brown to black heavy silt loam, varying in depth from 20 to 40 inches. These soil differences occur over such small areas that they can not be shown satisfactorily on a map of the scale used in this survey. Within the type there are also along intermittent streams narrow strips of colluvial material which are not differentiated.

This type includes a shallow phase in which the soil is similar to that of the main type and is underlain by a yellowish-brown stiff, compact silty clay which at about 30 inches grades into a mottled brown, yellow, and light-gray gritty clay. The nearness of the Kansan drift to the surface varies with the topographic position of this soil. The drift is usually exposed along gullies and steep slopes, while the divides are covered with a thick mantle of silt. Where the soil has a gritty texture and a probable derivation from the Kansan drift it is mapped as the Shelby loam, though there are a number of such areas too small to be shown separately and included with the silt loam. The Shelby silt loam also includes small areas of the Marshall silt loam, which owing to their close similarity to the former can not be satisfactorily separated. Along Weeping Water Creek and a few of its branches this type is extremely shallow, and includes many small areas of rock outcrop, indicated on the map by the conventional symbol. These spots are very rough and would be mapped as Rough stony land were they large enough.

In point of extent this is the second upland soil in the county. It occurs almost entirely as a single large body in the southern and southwestern part of the county, and has a rolling to steeply rolling topography. On the main divide it is rather gently sloping, but along the major stream courses the slopes are steep and dissected with

gullies. Along Weeping Water Creek the transition from upland to bottom land is frequently marked by very steep or precipitous slopes.

This type is well drained, and on the steeper slopes erosion is serious. For this reason the steep slopes and gullied areas are best kept in permanent pasture. When properly handled this soil, owing to its rather high organic-matter and clay content, is very retentive of moisture. Under the same farm management it is apparently more drought resistant than the Marshall silt loam.

The Shelby and Marshall silt loams are very similar in this county and differ mainly in point of origin. The Shelby silt loam is derived from the weathered phase of the Kansan drift, whereas the typical Marshall silt loam is derived from loess. The latter carries no pebbles or bowlders; the former a little of such coarse materials. There are also slight differences in structure and texture. The Shelby silt loam, as a result of its higher clay content breaks down into granules, while the Marshall silt loam breaks down to a fine powder. The Shelby silt loam does not stand up nearly as well in vertical banks as the Marshall. These two types grade imperceptibly into each other, and the boundary between them is necessarily largely arbitrary.

Over 90 per cent of the Shelby silt loam is in cultivation. Corn is by far the most important crop grown, and where properly tilled and rotated it does well on this type. Ordinary yields range from 30 to 40 bushels per acre, though as much as 70 bushels per acre is often obtained. Oats rank second in acreage. The yield ranges from 25 to 30 bushels per acre. The acreage of wheat is being gradually extended. Wheat does well on this soil, yielding from 20 to 25 bushels per acre. Very little of the type is devoted to the production of clover, timothy, and alfalfa. Owing to the difficulty experienced during recent years in starting clover, this crop has largely been displaced by alfalfa. The latter makes an excellent hay crop for the Shelby silt loam. Three and sometimes four cuttings per season are obtained, with an average yield of 3 tons of hay per acre. The tendency is to grow less corn, and more wheat and leguminous crops, and this change involves the keeping of more live stock. A few potatoes are grown, but not nearly enough for home consumption. Where properly cared for they do well, but most farmers give this crop very little attention.

Only a few of the farmers follow a definite, scientific crop rotation. The general plan is to keep the land in corn from 2 to 4 years, in oats 1 year, and in wheat 1 to 2 years, returning to corn. Occasionally the land is seeded to clover or alfalfa. In case the latter is sowed it is usually allowed to stand for 5 to 7 years. Fields which have been in corn or wheat for 5 to 10 years are not uncommon.

Land is generally plowed in the fall, except where the soil drifts. This type is somewhat more difficult to handle than the Marshall silt loam, and owing to its higher clay content it can not be cultivated under quite as wide a range of moisture conditions. When plowed too wet it bakes and forms clods that are rather difficult to break. Small checks and cracks form on this type, but not to a sufficient extent to cause any serious loss of moisture by evaporation. Where the land is disked before being listed for corn it withstands drought better. Manure is usually applied to this type either in the spring or fall, and either as a top dressing on winter wheat or on stubble fields. Where used as a top dressing on winter wheat, materially increased yields are obtained.

The Shelby silt loam is valued at \$125 to \$175 an acre, depending on improvements and location.

#### WAUKESHA SERIES.

The surface soils of the Waukesha series are dark brown to black, and the subsoils are yellow. These soils occur in areas of deep glacial drift. They are derived from water-assorted glacial débris deposited in broad filled-in valleys or as outwash plains and terraces. The topography is mainly flat to undulating. Drainage is good.

#### WAUKESHA SILT LOAM.

The Waukesha silt loam consists of a dark-brown to dark grayish brown, smooth silt loam, underlain at an average depth of 12 to 15 inches by a yellowish-brown silty clay loam which becomes more compact and lighter in color with increasing depth. Below 30 to 40 inches the material is looser in structure and similar in texture to the surface soil, and is yellow mottled with light gray. A number of exposed places on this type indicate a basal material of stratified sand about 10 feet or more below the surface. It is not known whether the basal material is uniformly a sand. The soil is rather high in organic matter. The subsoil is highly calcareous, the lime occurring as concretions, and is faintly marked with yellowish and brownish iron stains. This type has a vertical structure, but is more compact than the Knox silt loam.

The Waukesha silt loam is an inextensive type in Cass County. It occupies an area of 11.1 square miles on the higher terrace along Salt Creek in the northwestern part of the county and on the lower terraces of the same creek and of the Platte River.

A variation from these main bodies of the type is found along the smaller streams. In the latter areas the soil as far as is known is not underlain by basal sands, the fluvial silt being directly underlain by the glacial débris. This phase is very inextensive and occurs on the first terraces southeast of Union and on the second terraces west of

Union. The area west of Union is considerably modified by stream action, and it is rather difficult to determine whether it comprises terrace or upland material. The lower terraces are only 5 to 10 feet and the higher terraces 20 to 30 feet above the first bottoms.

The Waukesha silt loam occupies distinctly benchlike areas modified by stream erosion. In the middle of section 5, Greenwood Precinct, this type has an undulating topography; elsewhere it is rather flat to slightly undulating. In the section 5 referred to the area lies about 20 to 40 feet above the first bottoms of Salt Creek, and corresponds with the third terraces of Saunders County. The lower terraces along this stream are 10 to 15 feet above the streams. A few marshy, depressed areas occur in this type, though, in general, it is well drained. It withstands drought over long periods.

This type is derived from colluvial and alluvial silts, more or less modified by wind action. The material is loesslike and has been described as a valley form of loess<sup>1</sup> in Nebraska.

This type was originally prairie and the same grasses are native to this soil as to the upland soils. Approximately 95 per cent of the type is under cultivation to the staple crops commonly grown in the county. Corn yields 35 to 45 bushels, oats 35 to 40 bushels, wheat 20 to 30 bushels, and alfalfa 3 to 4 tons of hay per acre. During the last few years the clover and timothy crops have failed. The tendency on this type is to grow less corn and more wheat and alfalfa, and to keep more dairy cows and other live stock. A few potatoes are grown, but the quantity produced is not sufficient to supply home needs. Some sorghum is grown for home use.

The farmers as a rule do not follow any definite rotation. The prevailing practice is to keep a field from 2 to 3 years in corn, 1 year in oats, 1 to 2 years in wheat, and once in every second or third rotation 2 to 3 years in clover. Owing to the difficulty of securing a stand of clover, alfalfa is being substituted for this crop. The grass land is usually pastured during the last year, except on farms which include permanent pasture.

Owing to the stone-free nature, smooth surfaces, silty texture, and granular structure of the soil, this type is easily handled. Except where plowed too wet, it does not bake or clod. A small amount of barnyard manure is applied every 5 or 6 years. The productive capacity of this soil has been greatly impaired by lack of proper crop rotation.

The value of farm land on the Waukesha silt loam varies from \$150 to \$200 an acre.

<sup>1</sup>Unpublished manuscript of G. E. Condra.

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

*Mechanical analyses of Waukesha silt loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
370924, 370934 ....	Soil.....	0.0	0.2	0.2	1.7	21.2	65.1	11.6
370925, 370935.....	Subsoil.....	.0	.1	.1	.9	10.8	70.6	17.6

#### SIoux SERIES.

The Sioux series comprises dark-brown to black terrace soils occurring in the glaciated region of the Central and Northwestern States. These soils are characterized and distinguished from the Wabash soils by their occurrence on terraces above overflow and by the presence of a bed of gravel, usually within 3 feet of the surface. They differ from the Waukesha soils in their occurrence as comparatively narrow areas along streams instead of broad outwash plains associated with moraines.

#### SIoux FINE SANDY LOAM.

The soil of the Sioux fine sandy loam consists of a dark-brown to brown fine sandy loam about 15 inches deep, underlain by a yellowish-brown loamy sand. The material is more or less modified by silt washed from higher lying areas.

A narrow band of this soil occurs along the bluff line, between the Wabash silt loam and the Waukesha silt loam, north of Greenwood. It covers 64 acres in the county.

The Sioux fine sandy loam is derived from the basal material of the second terraces along Salt Creek. Owing to its very limited extent it is farmed with the Waukesha silt loam and is devoted to the same crops and farm practices. The crop yields are considerably lower, except where the fields are moistened by seepage water, than on the Waukesha silt loam type.

#### SCOTT SERIES.

The soils of the Scott series are dark brown to drab. The subsoils are lighter drab or brown. The members of this series consist of lake-laid material eroded from higher lying loessial soils and deposited by sheet surface waters or intermittent streams in the shallow waters of temporary lakes or ponds occupying local, undrained, sinklike depressions in upland plains. The soils are poorly drained, and in some places are subject to overflow.

## SCOTT SILT LOAM.

The soil of the Scott silt loam is a dark-gray to dark brownish gray silt loam, 11 to 15 inches deep. It is underlain by a pulverulent, floury silt of ashen-gray color mottled with rusty brown which contains an appreciable amount of very fine sand. At 28 to 36 inches a very dark drab stiff silty clay or clay mottled slightly with yellow is encountered. The lower subsoil is highly calcareous and contains some iron concretions. The upper layer of the subsoil is very loose, while the lower stratum is compact and impervious. Owing to the marshy condition of this type, a large amount of organic matter has accumulated in the surface soil.

Two typical areas of this soil are encountered within the Waukesha silt loam, in the northwestern part of the county. Two other areas, in which the soil varies somewhat from the typical, are mapped, one in association with the Marshall silt loam, flat phase, and one within the area of the Marshall silt loam, in the vicinity of Murdock.

The Scott silt loam occupies depressed, marshy areas which are very poorly drained. The upper section of this soil is apparently derived from silt, washed in comparatively recent time from the surrounding higher land and deposited over an older soil, which now constitutes the lower subsoil. The lower stratum, which is high in organic matter, is apparently a very old soil formed by the sifting in of clay and silts from standing water.

The native vegetation consists of sedges and wild marsh grasses, with prairie grasses and white clover along the border of the type.

This type has not been reclaimed and is utilized for pasturage. It is in need of drainage. When reclaimed it forms a good agricultural soil, and wheat, corn, and oats do fairly well.

The results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Scott silt loam are given in the following table:

*Mechanical analyses of Scott silt loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
370913.....	Soil.....	0.0	0.4	0.3	0.9	10.0	70.2	18.1
370914.....	Subsoil.....	.3	.5	.3	.5	10.0	77.3	10.9
370915.....	Lower subsoil...	.0	.6	.6	1.2	7.1	57.9	33.0

## WABASH SERIES.

The Wabash soils are prevailing black, ranging to dark brown, and contain a high percentage of organic matter. The subsoils are gray or brownish gray. 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. The Wabash areas are flat and poorly drained.

#### WABASH SILT LOAM.

The Wabash silt loam consists of a dark grayish brown or dark-brown to black, heavy, smooth silt loam, having an average depth of 24 inches. It is underlain by a more compact silt loam, which is usually somewhat lighter in color, though it is not uncommon to find little difference in color or texture in a 3-foot section. In places a black, compact silty clay is encountered at 18 inches. A large content of organic matter is characteristic of the surface soil of this type.

A heavier phase, commonly known as "gumbo," is encountered locally within this type in the Salt Creek bottoms. This phase consists of an extremely heavy silt loam to silty clay loam underlain at a depth of 20 to 24 inches by a heavy silt loam of mottled gray, yellow, and rusty brown. Along Salt Creek and its cut-off a narrow strip of lighter textured material is encountered. This usually consists of a dark-gray to grayish, coarse silt loam to very fine sandy loam, with an average depth of 10 to 15 inches, underlain by a stratum of light-brown material of the same texture which at about 24 inches merges into a lighter brown or a light-gray mottled with brown, very coarse silt loam.

The Wabash silt loam is the most important bottom-land soil in the county, covering a total area of 62.2 square miles. It occurs as first bottoms along the streams in the upland and to a small extent as a low bench above the Cass fine sandy loam on the Platte River bottoms.

The type has a flat topography and is only slightly dissected by old cut-offs. Along Salt Creek a low natural levee has been aggraded by stream action, while along Weeping Water Creek, between Wabash and Union, and the South Branch of Weeping Water Creek the stream is degrading. As a result of the latter condition a narrow first bottom, not wide enough to be shown on the soil map, has developed, giving the remainder of the bottom land along the drainage courses, a first-terrace appearance. Large quantities of colluvial material have been washed over this type on the north side of the bottom land along Weeping Water Creek.

Originally the drainage of this type as a whole was poor, but by cleaning the channels and clearing the land the conditions have been greatly improved. The area along Salt Creek is still rather poorly drained and is annually inundated, usually in early spring. The remaining areas are only occasionally overflowed.

The material composing this type is of alluvial origin. It is derived largely from wash from the Marshall and Shelby silt loams and to some extent from the Knox silt loam and other upland soil types of the county.

Originally most of these areas supported a forest growth, consisting of cottonwood, willow, elm, ash, black walnut, linden, hackberry and hickory. Approximately 75 per cent of the type is now in cultivation, being used for the production of the staple crops. In well-drained areas practically all of this land is devoted to corn, which produces higher yields than on any other soil type in the county. Yields of 45 to 55 bushels per acre are obtained ordinarily, and with the best of cultivation and favorable seasons as much as 90 bushels per acre have been obtained. Reids Yellow Dent gives the best results on the bottom land. Where this type has been devoted to the production of corn for a number of years and is well drained, wheat does well, yields of 25 to 30 bushels per acre being obtained. Kherson oats do fairly well and yield from 30 to 40 bushels per acre, but the long-straw oats are likely to lodge. Wheat and oats are not grown extensively. Where the Wabash silt loam lies high above the stream channel, or where its natural drainage is supplemented by a few ditches, alfalfa gives excellent results, producing heavier yields than on the upland soils. From 3 to 5 tons of hay per acre are obtained from this crop. The greater part of this soil is in hay land and pasture. Wild hay yields from 1 to 2 tons per acre, and in favorable years as much as 3 tons is sometimes harvested. Owing to the fact that this land affords good pasturage and produces large yields of hay, the production of beef is more general than on the upland.

The one-crop system prevails on this type, though occasionally the corn is rotated with oats and wheat. It is not uncommon to find a field which has been in corn for 15 years.

Owing to its flat topography, silty texture, and friable structure this soil is easily handled. It can be cultivated under a wide range of moisture conditions and seldom bakes or clods, except in the "gumbo" spots, which are rather difficult to till. The Wabash silt loam is more drought resistant than the Shelby silt loam during short, dry spells, but the latter type seems better able to withstand protracted periods of drought.

The productiveness of this soil where it has been cultivated for a long time has decreased, owing to the one-crop system of farming practiced. Scarcely any barnyard manure and no commercial fertilizers are used. On areas that have been reclaimed or are naturally fairly well drained the occasional rotation of corn with grain and leguminous crops seems to be sufficient to maintain the productiveness of the soil.

The value of farm land on this type ranges from \$80 to \$150 an acre, depending on drainage conditions.

*Wabash silt loam, colluvial phase.*—The Wabash silt loam, colluvial phase, is a dark-brown to black heavy silt loam, with an average depth of 24 inches. The surface soil is very friable and mellow, and, as the color indicates, contains much organic matter. The subsoil is a more compact dark grayish brown heavy silt loam, differing little in texture or color from the soil.

This phase occupies a small area, in all only 2.6 square miles. Most of it occurs along Weeping Water Creek, though several small areas are scattered in other parts of the county. Other strips of the colluvial phase, too narrow to be shown separately on the map, were included with the typical soil.

The colluvial phase of the Wabash silt loam occupies a position between the upland and bottom land soils. It has an appreciable slope and is well drained. In a few instances it occurs along intermittent streams where there has been considerable side-hill wash.

The material is derived from the wash of the Knox, Marshall, and Shelby soils.

Practically all of this phase is devoted to the production of corn, though a few small areas are in wheat and oats. Corn yields from 45 to 60 bushels per acre, while as much as 100 bushels have been obtained.

No crop rotation is practiced on this phase, and scarcely any barnyard manure is applied. The soil is easily cultivated, and can be worked under a wide range of moisture conditions. There are no farms composed entirely of this soil. This land is valued at \$125 to \$150 an acre.

#### WABASH CLAY.

The Wabash clay is a dark-drab to black silty clay to an average depth of 18 inches, underlain by a silty clay to clay of dark gray, mottled with yellow and brown colors. The soil breaks into granules and checks and cracks considerably. It has a high organic-matter content. The lower part of the subsoil is highly calcareous, the lime existing in the form of shells and concretions. In the strip of this type near the Missouri River, a mantle of yellowish-gray very fine sandy loam, varying from 2 to 8 inches in thickness, covers the typical soil.

This type is inextensive and occurs entirely in the southeastern part of the county, in the first bottoms at the mouth of Weeping Water Creek.

The Wabash clay has a flat topography and was originally poorly drained. Practically all of the type has been provided with ditches, though it is generally necessary to install tile drains also in order to

give it thorough drainage. It is subject to annual overflows, which occur early in the spring.

This type owes its origin to the silting up of the old abandoned channels of the Weeping Water Creek and the Missouri River. About 50 years ago, according to reports of farmers, the main channel of the Missouri River was located where the largest Wabash clay areas now occur.

The Wabash clay is devoted mainly to grain farming. Corn, wheat, and Kherson oats do well, except during wet years, when the excess moisture is not removed fast enough by the present drainage system. Corn yields 40 to 70 bushels, wheat about 30 bushels, with a maximum yield of 55 bushels, and Kherson oats about 30 bushels per acre. A small part of the type is in wild grasses, which produce an average of  $2\frac{1}{2}$  tons of hay per acre. The Wabash clay is the most difficult soil to handle in Cass County. When cultivated too wet it forms intractable clods, though under favorable moisture conditions the soil works up into a rather mellow seed bed. But little barnyard manure and no commercial fertilizers are used.

The establishment of systematic drainage with tiles about three rods apart is necessary throughout this type. Without proper drainage the maximum crop-producing capacity of this soil can not be realized.

Farm land on this type ranges in value from \$80 to \$90 an acre.

#### CASS SERIES.

The surface soils of the Cass series are dark brown to black. The subsoils are lighter in color and in texture. These soils are alluvial, and most extensively developed in the bottoms along the Mississippi and Missouri Rivers and their tributaries. They occur in association with the Sarpy soils, occupying, however, areas having somewhat less perfect drainage, because subject to overflow. Between the high stages of the streams the drainage is thorough.

#### CASS FINE SANDY LOAM.

The surface soil of the Cass fine sandy loam consists of 2 to 3 inches of dark-brown loam resting on a gray to dark-gray fine sandy loam, extending to depth of 10 to 15 inches. The surface soil is underlain by a loose, incoherent, almost white, fine sand, which becomes coarser with depth. Occasionally some fine gravel is encountered in the third foot, but this material usually occurs at greater depth. Where the soil has been under cultivation for some time, and the supply of organic matter depleted, the soil has a light-gray color, but ordinarily the content of organic matter is fairly high. Streaks of black silt and clay are common in the soil and subsoil.

In the depressions and sloughs of this type, the soil is a black, light-textured loam, 8 to 12 inches deep, underlain by the typical subsoil. Such areas are very small, and can not be shown separately on the map.

The Cass fine sandy loam comprises 4.1 square miles, and occurs along Platte River, in a narrow disconnected strip, from a few rods to about three-fourths of a mile in width.

In general the topography is level, though in detail it is marked by slight ridges. There are numerous sloughs, which, like the low ridges, run in the same general direction as the Platte River. The surface soil is well drained, although owing to the high water table the drainage of the subsoil is poor. The water table lies between 4 and 5 feet below the surface. This type is 3 to 4 feet lower than the Cass very fine sandy loam, and the Cass silt loam, and is subject to annual overflows.

Where the type has not been changed by overflow for some time, it supports a forest growth, consisting mainly of cottonwood, willow, elm, ash, box elder, basswood, with a scattering of walnut, hackberry, coffee bean, mulberry, honey locust, and cedar.

A small part of this type is used for corn and wheat production with fair results. The greater part of the type is used as pastures. Owing to its high water table the grasses make good growth, and it is well adapted to grazing.

Where the soil is cultivated it is necessary to apply large quantities of organic matter, in order to increase the humus content. A good rotation on this type consists of corn for one year, oats one year, and alsike or some other leguminous crop for a few years. The lower areas of this type are best used for pasture or hay land.

The value of land on this type ranges from \$50 to \$90 an acre.

#### CASS VERY FINE SANDY LOAM.

The Cass very fine sandy loam consists of a dark brownish gray very fine sandy loam, 12 to 15 inches deep, underlain by a light-gray very fine sandy loam. The soil is fairly high in organic matter, and the subsoil is slightly marked with rusty-brown iron stains. This type is inextensive, occupying about 64 acres along Salt Creek, just above its mouth, where it forms a low levee. It is thoroughly drained but is subject to annual overflow.

Practically all of this type is forested. The growth consists of willow, cottonwood, ash, elm, box elder, and hackberry.

The results of mechanical analyses of samples of the soil and sub-soil of the Cass very fine sandy loam are given in the following table:

*Mechanical analyses of Cass very fine sandy loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
370916.....	Soil.....	0.1	0.7	2.6	17.2	32.4	37.6	9.6
370917.....	Subsoil.....	.0	.6	3.0	14.4	43.2	33.6	5.3

CASS SILT LOAM.

The soil of the Cass silt loam is a dark-gray to black, rather heavy silt loam, 12 to 18 inches deep. The subsoil is underlain by a light-gray, very fine sandy loam, marked with brown iron stains. The subsoil becomes coarser with depth, and a medium sand with a small admixture of fine gravel is commonly encountered at 36 to 40 inches. The soil has a high organic-matter content.

This type is inextensive, having a total area of a little over 1 square mile. It occurs in the Platte River first bottoms, the largest areas being in the vicinity of Oreapolis.

The surface is flat and traversed by a few meandering streams. The type occupies a transitional zone between the slightly higher Wabash silt loam and the slightly lower Cass fine sandy loam, except in Secs. 35 and 36, T. 13 N., R. 13 E., where it occupies a slightly depressed area. Owing to the underlying light-textured material, this type possesses fair drainage, except when the Platte River is above normal flow. The depressed areas are occasionally inundated.

Originally most of this type was covered with marsh grasses, sedges, and rushes. Practically all of it is now reclaimed. It is largely devoted to the production of corn, with wheat and hay as subordinate crops. Corn yields from 40 to 60 bushels per acre. Owing to the natural productiveness of this soil, the rotation of crops receives little attention, and the fields are usually planted in corn until an appreciable reduction in crop yield takes place when some small grain crop is substituted for a few years. Many fields have been in corn continuously for 15 to 20 years.

This type is rather easy to handle, although a heavy farm equipment is required for thorough tillage. Only small quantities of barnyard manure are applied, and no commercial fertilizers are used. There is general need for the practice of crop rotation.

The Cass silt loam is valued at \$125 to \$150 an acre, depending on improvements and location.

## CASS CLAY.

As it occurs in Cass County, the soil of the Cass clay consists of a silty clay to clay, the color of which ranges from dark gray to dark gray mottled slightly with brown. This is underlain at an average depth of 15 inches by a silty clay of gray to bluish gray mottled with brown and reddish-brown colors. Below 26 inches the material consists of a very fine sandy loam of practically the same color as the overlying stratum, and at about 30 inches an almost white, fine sand is encountered. Streaks of clay are very common throughout the light-textured portion of the subsoil. The subsoil contains a relatively large proportion of lime. Owing to its swampy condition, a fairly large quantity of organic matter has accumulated in the surface soil. On drying the soil breaks into granules and has a texture apparently much lighter than clay.

This type is not extensive in Cass County. It occurs as small, depressed areas in the first bottoms of the Missouri River. It lies at some distance from the stream, with the lighter types of the Sarpy series between it and the river. The type occupies low, flat areas, and is poorly drained. The Cass clay owes its origin to the silting up of abandoned channels of the Missouri River.

The area of this type at Plattsmouth is cleared, while the other areas are largely covered with a dense growth of willows, cottonwood, and low scrubs. Practically all of this type is used for pasture. The cost of diking and draining is too great to warrant reclamation at the present time, and its present use is probably the best that can be found for it.

The value of the land ranges from \$30 to \$80 an acre, depending on location.

## SARPY SERIES.

The soils of the Sarpy series range from light gray to dark brownish gray or nearly black. They differ from the Wabash and Yazoo soils in having loose silty or fine sandy subsoils, distinctly lighter in texture than the surface soils. This series is developed in the bottoms of the Mississippi and Missouri Rivers and their larger tributaries. The material is alluvial in origin. Owing to their low position these soils are subject to overflow, although between the flood stages of the streams the nature of the soil and subsoil is such that drainage is thorough to excessive. In general the topography is flat.

## SARPY FINE SAND.

The Sarpy fine sand consists of a dark brownish gray to gray loamy fine sand, underlain at an average depth of 15 inches by a light-gray, loose, incoherent fine sand which immediately passes into an almost white fine sand of the same texture. The subsoil becomes coarser

with depth, and some medium sand and small gravel are commonly encountered in the lower part. It is always more or less stained with iron.

This type is of small extent. It occurs in the lower part of the Platte River bottom and on islands in that river. It forms ridges, lying from a few feet to 10 feet above the surrounding soil types, and is thoroughly to excessively drained.

The Sarpy fine sand is derived from the coarser material forming the banks of old overflow channels and of the Platte River, with the addition of some wind-blown material, and also from sands washed over the bottom lands during recent ice gorges.

The type is practically nonagricultural. It supports a scant growth of grasses and a forest growth similar to that on the Cass fine sandy loam. It affords fairly good pasturage during the early spring. The soil is subject to drifting, and is best kept in native grasses or timber. The Sarpy fine sand is valued at \$15 to \$30 an acre.

The results of mechanical analyses of samples of the soil and subsoil of this type are given in the following table:

*Mechanical analyses of Sarpy fine sand.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
370920.....	Soil.....	1.2	8.0	15.6	45.2	20.4	7.1	2.5
370921.....	Subsoil.....	.1	1.5	12.7	73.4	11.2	.7	.3

SARPY VERY FINE SANDY LOAM.

The Sarpy very fine sandy loam consists of a light yellowish gray very fine sandy loam, 10 to 15 inches deep, underlain by a somewhat lighter yellowish gray very fine sandy loam. The subsoil consists of alternate layers of sand, silt, and clay, and seams of silt and clay are not uncommon in the surface soil. The soil is very low in organic matter.

This type differs from the Cass very fine sandy loam in that it is lighter in color, contains less organic matter, and is more subject to change by overflow. It is not extensive in Cass County, occurring in discontinuous strips, varying from a few rods to a little over one-half mile in width, along the Missouri River. It is elevated about 8 feet above the normal flow of the stream. The surface is in general flat, though marked by slight ridges. When the Missouri River is low the drainage is good; at high stages of the stream the type is subject to overflow.

The greater part of the type either supports a thick growth of willow or, where the soil has not been changed by floods for some

time, is in forest, comprising cottonwood, elm, box elder, and willow. Such areas are well suited for pasturage. A small part of the type has been reclaimed and is devoted largely to corn. This crop does fairly well, yielding from 30 to 40 bushels per acre. The type is well adapted to watermelons and muskmelons, which are grown to some extent, and to other truck crops.

The Sarpy very fine sandy loam is very easily handled and can be worked under a wide range of moisture conditions. Only a small amount of manure is added to the reclaimed areas and no commercial fertilizers are used. The type is in need of organic matter. The land values range from \$30 to \$80 an acre.

#### SARPY SILT LOAM.

The soil of the Sarpy silt loam is a brownish to yellowish-gray or grayish-yellow silt loam 12 to 15 inches deep, containing a high percentage of very fine sand. It is underlain by a light yellowish gray very fine sandy loam, which frequently includes seams of heavier and also of coarser material. The change in color between the soil and subsoil is not marked by a distinct line, although as a rule the lower subsoil is a shade lighter in color and streaked with numerous rusty-brown iron stains. The soil is rather low in organic matter.

This type differs from the Cass silt loam in that it carries less organic matter and is lighter in color. It is developed in a few small areas in the Missouri River bottoms and has a total area of approximately 1 square mile.

The type is fairly well drained and has a flat, slightly ridged topography. It lies about 6 to 10 feet above the normal level of the river. Owing to the high water table it is very drought resistant.

The greater part of this type is under cultivation and devoted mainly to corn. This crop yields from 30 to 50 bushels per acre.

The value of land of this type ranges from \$50 to \$100 an acre, depending on the extent to which it is subject to erosion by the Missouri River.

#### MISCELLANEOUS MATERIAL.

##### RIVERWASH.

Riverwash, as mapped in Cass County, consists largely of mud areas, silty flats, and sand bars along the Missouri River and sand flats and sand bars along the Platte River. The Riverwash of the Platte River is considerably coarser than that along the Missouri River. It consists of a light-colored, fine, medium, and coarse sand with an admixture of fine gravel. About 1.9 square miles of this type is mapped in the county.

The type is a few feet above the normal flow of the river and is inundated with each slight rise of the streams. It is changed by every

overflow, and even during the normal flow of the streams the type is washed away in some places and rebuilt in others. The material is considerably modified during storms by wind action, especially along the Missouri River. This type is practically devoid of vegetation.

#### SALINE SOILS.

The saline soils of Cass County are indicated by symbols on the soil map. They consist of dark-brown, extremely heavy indurated silt loam, underlain by brownish-yellow or yellow, slightly indurated silty clay loam. There is a whitish veneering of silty material over the surface soil, with a high sodium chloride content. Salt-tolerant plants constitute the chief growth, and in places the content of water-soluble salts is too high to permit the growth of even these kinds of vegetation. These peculiar spots are spoken of in the county as alkali and by some as "gumbo." The term "gumbo" as used by most farmers in the county applies to heavy spots in a soil type or the heavy soil areas.

The saline spots occur almost entirely in the northwestern part of the county, within the Salt Creek drainage system. They are encountered along the drainage ways on the slopes between the upland or alluvial terraces and the first bottoms.

The Dakota sandstone, which is locally highly impregnated with sodium chloride, undoubtedly largely gives rise to the saline spots in the upland region and terraces. A sample of the soil from a saline area in this county analyzed 0.25 per cent of water-soluble salts, 0.06 per cent being bicarbonate and the remainder mainly sodium chloride. According to Hilgard, greasewood, a salt-tolerant plant, will not grow on soils higher in these salts than 3,680 pounds per acre-foot. As the sodium chloride content of the saline spots of this county is even higher than this, it is evident that the barren surface or the stunted growth of prairie grasses or farm crops is caused by an excess of sodium chloride.

No effort has been made to reclaim the saline spots. The "gumbo" spots, which are not indicated on the map, are improved by turning under large quantities of coarse manure and straw to loosen the soil.

#### SUMMARY.

Cass County adjoins the eastern boundary of Nebraska and is just south of the Platte River. It has an area of 552 square miles, or 353,280 acres. The topography varies from almost flat to rough and extremely dissected.

The lowest elevation, at a point in the southeastern corner of the county, is recorded as 928 feet, and the greatest, recorded at a point just west of Eagle, is 1,360 feet above sea level.

The county is drained by five important streams and their tributaries, the Platte and Missouri Rivers, Weeping Water, and Salt Creeks, and the headwaters of Little Nemaha River. The general direction of the drainage is toward the southeast, and in general every part of the county is well drained.

The first permanent settlement in Cass County was made in 1853, and the county was organized in 1855. The first settlers came from the Eastern States. At a later date a number of foreigners settled in the county.

The population of Cass County is given in the 1910 census as 19,786.

Plattsmouth is the county seat. This town is located in the northeastern corner of the county and has a population of about 4,300.

The railroad facilities in Cass County are good. No part of the county is more than 8 miles from a railroad station.

All parts of the county are supplied with rural mail delivery and telephone service.

The climate of Cass County is favorable for the growing of corn, wheat, oats, and alfalfa and other forage crops. The annual precipitation averages about 30 inches, and the mean annual temperature is about 51° F. The normal growing season is sufficiently long for the maturing of most general farm crops.

Grain farming is the chief type of agriculture practiced, though the production of beef, pork, and dairy products is becoming more important.

Corn, wheat, oats, wild grasses, alfalfa, and clover are the principal farm crops, and timothy, potatoes, barley, sorghum, buckwheat, and rye also are grown to some extent.

In the eastern part of the county some attention is given to orcharding.

Truck crops are produced on a small scale.

No definite crop rotation is practiced, and the adaptation of crops to the various soils of the county receives but little attention.

Excluding Riverwash, 17 soil types, representing 10 series, are recognized in Cass County. They may be classed in three groups—the upland soils, terrace soils (old alluvial), and first-bottom (recent alluvial) soils.

The Marshall silt loam is the most extensive upland soil of Cass County, and is considered the best upland type for grain farming. Corn, wheat, and oats are the chief crops grown. The flat phase of the Marshall silt loam is very limited in extent and is devoted to the same agricultural practices as the main type, although, owing to its smooth topography, it is considered a better soil.

The Lancaster fine sandy loam is very inextensive and, owing to its steep topography and light texture, is not well suited to grain farming. It is best adapted to the growing of early vegetables.

The Knox silt loam is a light-colored loess soil. It occupies chiefly the bluff zone along the Platte and Missouri Rivers. Owing to its dissected topography this type is not adapted to grain farming. It is, however, well suited to apples.

The She by loam is glacial in origin, but is derived from a stratum which gives rise to a rather stony soil. It is used largely for pasturage, though where the slope is not too steep and the stone content is low corn, oats, and wheat do well.

The Shelby silt loam is glacial in origin and occurs largely in the southern and southwestern part of the county. It is considered a good agricultural soil and is largely utilized for the production of corn, wheat, and oats. It is very similar to the Marshall silt loam.

The Waukesha silt loam is considered the best agricultural soil of the county. It belongs to the second-terrace group and is admirably adapted to corn, oats, and wheat.

The Sioux fine sandy loam is derived from the basal material of Waukesha silt loam. It is not an important soil in this county.

The Scott silt loam occurs as depressed areas in association with the Waukesha and Marshall silt loams. It is used mainly for pasturage.

The Wabash silt loam is the dominant first-bottom soil of the survey. It is the best corn soil in the county, though not nearly as well adapted to wheat and oats as to corn. The colluvial phase of this type is not extensive, and is largely devoted to the raising of corn.

The Wabash clay is a very inextensive type. It occurs at the mouth of Weeping Water Valley, and is devoted to the growing of corn, oats, wheat, and wild hay. This soil is more difficult to handle than any other reclaimed type in the county.

The Cass fine sandy loam is an alluvial soil which occurs as a narrow, discontinuous strip along the banks of the Platte River. It is largely used for pasturage.

The Cass very fine sandy loam occurs as a low natural levee along Salt Creek. Practically all of this type is forested. It is encountered in the Missouri River first bottoms. Only a small part of the type is reclaimed.

The Cass silt loam is an alluvial soil of the Platte and Missouri River bottoms. It is very productive, and is well adapted to corn.

The Cass clay is a low-lying, poorly drained soil in the Missouri bottoms. The greater part of the type is unreclaimed, and is used for pasturage.

The Sarpy fine sand occurs as islands in the Platte River and as narrow ridges in the bottoms of this stream. It is very droughty, and has a low agricultural value, being used only for spring pasturage.

The Sarpy very fine sandy loam is encountered in the Missouri River first bottoms. Only a small part of the type is reclaimed. It is used mainly for pasturage, the cultivated areas being devoted to corn.

The Sarpy silt loam is an inextensive type occurring in the Missouri River bottoms. The greater part of the type is under cultivation and devoted mainly to corn.

Riverwash comprises the sand bars and flats of the Platte River and the mud and silt flats and sand bars of the Missouri River. It is constantly being changed by overflows and wind action, and is practically devoid of vegetation.

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