

# SOIL SURVEY OF HOWARD COUNTY, NEBRASKA.

By F. A. HAYES, in Charge, and L. S. PAINE, of the U. S. Department of Agriculture, and D. L. GROSS and O. M. KRUEGER, of the Nebraska Soil Survey.

## DESCRIPTION OF THE AREA.

Howard County is situated in the east-central part of Nebraska, about 58 miles east and 20 miles south of the geographical center of the State. It is square in shape, each boundary being approximately 24 miles long, and its total area is 561 square miles, or 359,040 acres.

Howard County lies near the eastern margin of the Great Plains region. It forms part of a broad, eastwardly sloping plain upon which minor relief has been produced by stream erosion and wind action. About four-fifths of the county consists of upland and the remainder of terrace and bottom lands.

The upland may be roughly divided into three areas, separated by the broad valleys of the Middle Loup and North Loup Rivers, which join in the northeastern part of the county to form the Loup River.

The largest of these divisions occupies the broad plain in the western part

of the county between the two streams. This area is partly dissected and given minor relief by the narrow valleys of Deer, Oak, Turkey, and Davis Creeks. Except for the most northern part and the valley slopes, the topography is more nearly level than any other part of the upland. The divides are flat to very gently undulating and represent slightly modified remnants of an originally continuous eastward-sloping plain.

The upland division lying north of the Loup and North Loup Rivers is much more dissected than the area already described. It is cut by an intricate system of small, steep-sided drainage ways separated by narrow crestlike divides and ridges. The general surface is below that of the original undissected upland, and only the crests of the broader divides approach the level of the former plain. The slopes bordering the main streams are comparatively smooth, though much shorter and less gradual than those of the other upland divisions. In a few places the river is separated from the upland by steep, blufflike escarpments.

The upland division lying south of the Loup and Middle Loup Rivers is considerably lower in elevation than the other upland divisions. The topography ranges from undulating to hilly, the greater part having a gently rolling to billowy surface modified

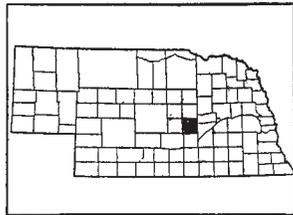


FIG. 30.—Sketch map showing location of the Howard County area, Nebraska.

in places by small irregular depressions. The rougher topography occurs as narrow strips bordering the alluvial lands along the larger streams, and the more nearly level areas lie south and east of the Bunker Hill School. Within this division along the eastern county line and in the extreme southeastern part of the county are extensive areas of terrace lands.

The alluvial land, which occupies about one-fifth of the county, consists of smooth plains lying mainly along the Loup Rivers, partly above existing flood level and partly below it.

The elevation in Howard County averages about 1,940 feet above sea level, varying from approximately 1,740 feet, where the Loup River crosses the eastern boundary to about 2,140 feet in the northwestern corner and along the western county line. The elevation of the first bottoms and terraces of the Loup Rivers ranges from 1,740 to 1,900 feet, while the average elevation of the upland is about 2,000 feet above sea level. The general slope is to the south and east, with a fall of about  $12\frac{1}{2}$  feet per mile.

All the rivers and larger creeks are permanent streams. The minor drainage is intermittent. The county as a whole is well drained. The surface drainage is good, except in small depressional areas in the western upland division and over much of the southeastern part of the county, where the surface water sinks into the porous sands and seeks outlet through subterranean channels.

The territory now comprising Howard County was included in Hall County until March 28, 1871, when it was organized with its present boundaries by act of the State legislature. Settlers began coming in March 31, 1871. The first settlers were of Danish descent and came from Wisconsin.

The population of the county, as reported by the census, increased from 4,391 in 1880 to 10,739 in 1920. It consists mainly of settlers from eastern States. The entire population is classed as rural, there being no towns with 2,500 inhabitants. The agricultural population is unevenly distributed, being densest in the vicinity of the towns, within the river valleys, and in the southern part of the western upland division. The northern and southeastern parts of the county are the most sparsely settled.

St. Paul, the county seat, with 1,615 inhabitants, is centrally located and an important railroad point. The railroad shops afford employment for many men. Among the smaller towns, Boelus, Dannebrog, Elba, Cotesfield, Farwell, Cushing, and St. Libory are shipping points and markets of local importance.

Transportation facilities are good throughout the county, no point being more than 8 miles from a railroad. A branch of the Union Pacific Railroad from Grand Island to Ord crosses the county in a southeast-northwest direction. The towns of St. Libory, St. Paul, Elba, and Cotesfield are on this line. A spur of this branch extends southwest from St. Paul through Dannebrog and Boelus to Loup City in Sherman County. A branch of the Chicago, Burlington & Quincy Railroad from Central City to Sargent crosses the central part of the county east and west. St. Paul and Farwell are on this line. Another branch of this railroad crosses the northeastern corner, passing through Cushing.

Most of the public roads, except a few in the rougher parts of the county, follow section lines. All of them are earth roads. The

more important highways are dragged as soon after each rain as the ground allows and are kept smooth. Little attention is given to the minor roads. Telephones and rural delivery routes reach all sections of the county.

The surplus products, consisting principally of wheat, corn, cattle, and hogs, are marketed outside the county, chiefly in Omaha. Most of the grain is handled in local elevators, where it may be sold at once or stored until the price is satisfactory. Much of the dairy and poultry products is shipped to Grand Island.

## CLIMATE.

The climate of Howard County is marked by rather wide seasonal variations. The winters are fairly long and the summers rather warm. The spring usually is cool, with considerable precipitation. The fall season is long, with moderate temperatures and occasional periods of rainy weather. The rainfall is moderate, the humidity relatively low, and the rate of evaporation rather high. There is not sufficient variation in surface characteristics to cause any appreciable differences in climate within the county.

The table below, compiled from the records of the Weather Bureau station, gives the normal monthly, seasonal, and annual temperature and precipitation at St. Paul:

*Normal monthly, seasonal, and annual temperature and precipitation at St. Paul.*

(Elevation, 1,796 feet.)

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1910).	Total amount for the wettest year (1905).
	° F.	° F.	° F.	Inches.	Inches.	Inches.
December.....	27.1	75	-25	0.66	0.87	
January.....	24.6	65	-30	.43	.69	1.14
February.....	25.7	78	-32	.77	.04	.86
Winter.....	25.8	78	-32	1.86	1.60	2.00
March.....	37.6	89	-11	.92	.19	1.02
April.....	50.4	98	12	2.39	.28	4.15
May.....	61.0	97	25	3.60	2.75	7.70
Spring.....	49.7	98	-11	6.91	3.22	12.87
June.....	70.6	104	37	4.78	2.46	8.41
July.....	75.9	111	44	4.22	4.44	7.47
August.....	74.7	109	39	3.22	4.56	3.49
Summer.....	73.7	111	37	12.22	7.46	19.37
September.....	65.9	102	22	2.48	1.56	5.26
October.....	53.0	94	12	1.77	1.43	.96
November.....	39.4	84	-8	.86	.21	1.74
Fall.....	52.8	102	-8	5.11	3.20	7.96
Year.....	50.5	111	-32	26.10	15.48	42.20

The mean annual precipitation is 26.1 inches. The precipitation is heaviest during May, June, July, and August. The mean annual precipitation for November, December, January, and February is

less than 1 inch per month. The greater part of the rainfall in the summer occurs in local thunderstorms. The rainfall in May and June is usually well distributed, and periods of drought are almost unknown. In July the distribution is less favorable, and during August and September long periods of drought occasionally cause reduced yields of grain. Crop failures, however, are rare even on the more sandy soils, as most of the soils are retentive of moisture when properly handled. The precipitation in the wettest year on record (1905) was 42.20 inches, of which 23.58 inches fell during May, June, and July. In the driest year (1910) the precipitation was only 15.48 inches. The average annual snowfall is about 23 inches.

The mean annual temperature is 50.5° F. The mean for the summer months is 73.7° F. July is the warmest month, with a mean of 75.9° F., and January the coldest, with a mean of 24.6° F.

The average date of the last killing frost in the spring is May 6, and that of the first in the fall, October 3. This gives an average growing season of 149 days, which is ample for the maturing of corn and all other crops commonly grown. In the 20 years from 1895 to 1914 there were four seasons in which the last killing frost was 10 days or more later in the spring, and the earliest was 10 days or more earlier in the fall, than the average. Killing frost has been recorded as late in the spring as May 27 and as early in the fall as September 12.

During most of the year the prevailing winds are from the northwest, but in June, July, and August the winds are mainly from the south and southeast. The proportion of clear and sunshiny days is relatively high.

#### AGRICULTURE.

Howard County is essentially agricultural. The land originally supported a luxuriant growth of prairie grasses, with marginal strips of forest along the larger streams. Grazing was the principal industry in the early days, but was never so important as in the western counties of the State. The first land was broken about 1872 and planted to corn and wheat, which, with beef and game, formed the chief foods. The early development of the county was slow on account of the absence of markets and transportation facilities. The building of the first railroad gave a marked impetus to agriculture.

In the earlier days the farming methods were crude and wasteful. Little attention was given to the preparation of the seed bed, to seed selection, crop rotation, and fertilization. At present there is a tendency to improve the crops by careful seed selection and to increase the productiveness of the soil by crop rotation, manuring, and growing leguminous crops such as clover and alfalfa. There is, however, much room for improvement in farming methods even now.

The agriculture of Howard County at present consists of diversified farming, including grain farming and stock raising. According to the census reports, the principal farm crops are corn, wheat, oats, wild hay, alfalfa, rye, and barley, ranking in acreage in the order named.

The table below, compiled from the reports of the Federal Census, shows the trend of agriculture in Howard County:

*Acreage and production of principal crops in 1879, 1889, 1899, 1909, and 1919.*

Crop.	1879		1889		1899		1909		1919	
	Area.	Production.	Area.	Production.	Area.	Production.	Area.	Production.	Area.	Production.
	<i>Acres.</i>	<i>Bushels.</i>	<i>Acres.</i>	<i>Bushels.</i>	<i>Acres.</i>	<i>Bushels.</i>	<i>Acres.</i>	<i>Bushels.</i>	<i>Acres.</i>	<i>Bushels.</i>
Corn.....	8,590	300,860	56,434	2,040,320	79,733	2,111,000	76,630	2,059,487	67,664	1,854,434
Oats.....	3,433	93,976	20,704	458,996	21,678	477,400	21,626	395,457	28,001	575,783
Wheat.....	19,023	217,838	18,805	217,730	44,138	389,580	44,501	879,234	51,741	646,290
Rye.....	325	4,809	892	13,292	6,538	79,020	1,505	16,091	8,704	94,693
Barley.....	761	13,555	1,052	16,357	880	14,040	359	7,334	4,846	118,903
Potatoes.....		32,482	1,185	72,628	1,322	120,467	1,017	66,066	878	34,814
Hay and forage..	4,259	<i>Tons.</i> 5,130	28,034	<i>Tons.</i> 33,055	28,241	<i>Tons.</i> 28,442	43,319	<i>Tons.</i> 71,950	51,063	<i>Tons.</i> 77,541

Corn is the leading crop and is the chief cash crop on farms where it is not fed to livestock. The census reports 67,664 acres in corn in 1919, and a production of 1,854,434 bushels. The State board of agriculture reports 87,524 acres in corn in 1920, and a total yield of 3,063,340 bushels. On farms operated by owners most of the corn is fed to hogs, beef and dairy cattle, and work stock, but on tenant farms more of the corn is sold. There are 81 silos in the county, and on farms where these occur from 15 to 20 acres of corn are cut each year for silage. It is a common practice to husk the corn from the standing stalks in the fall and pasture cattle and horses in the fields during the winter. Many farmers fence off a few acres of unhusked corn for hog range. A small acreage is cut for forage. The less progressive farmers grow corn on the same land five or six consecutive years. Much better yields are obtained, however, where it is grown in rotation with small grains and alfalfa. In recent years some attention has been given to the improvement of the seed corn, but seed selection is not generally practiced. The leading varieties of corn are Reid Yellow Dent, Nebraska White Prize, and Iowa Silvermine. The crop is raised on all the soils of the county except the poorly drained land in the flood plains, the sandier members of the Valentine series, and Dunesand. The loessial soils of the upland and the heavier terrace soils are preferred on account of the higher yields.

Wheat ranks second in acreage. The census reported 51,741 acres in wheat in 1919, and a production of 646,290 bushels. The State board of agriculture reports 28,111 acres devoted to wheat in 1920, with a total yield of 279,511 bushels. Most of the wheat acreage is devoted to winter wheat. The average yield of winter wheat for the last three years (1918, 1919, 1920) is reported as 11½ bushels per acre, and that of spring wheat as 9 bushels. The yield of winter wheat fluctuates less than that of spring wheat. There is some danger of winterkilling, but this has been greatly reduced since the introduction of the Turkey variety. Smut and rust are often quite destructive to spring wheat, though they seldom injure winter wheat. The yields of both kinds are sometimes reduced by the Hessian fly.

Wheat is usually cut with a binder. In exceptionally dry seasons, when the stems are too short for binding, the grain is headed. The crop is shocked or stacked in the field for threshing. Most of the grain is sold direct from the threshing machine, but a few farmers store their grain for a more satisfactory market.

Oats usually rank next to wheat in acreage. As in the case of wheat, the area devoted to oats fluctuates greatly from year to year, depending upon the price. In some years oats lead wheat in acreage. The census reports 28,001 acres in oats in 1919, and a production of 575,783 bushels. The State board of agriculture reports 23,328 acres devoted to oats in 1920, with a total yield of 723,168 bushels. Kher-son, Swedish Select, and Silvermine are the leading varieties. Very little effort is made to control smut, although the disease often lowers crop yields during wet seasons. The crop is usually cut with a binder and either shocked or stacked for threshing. The grain is used largely as feed for horses and other stock, and some is sold. The straw is usually left in the field, and stock is given access to the stacks. A little of the straw is baled and shipped. Some farmers procure seed from other sections. Many, however, simply clean a sufficient amount of the previous crop for seed. Oats are grown on all but the sandier and more poorly drained soils of the county. The crop does best upon the loessial uplands and the heavier textured soils of the terraces.

Alfalfa was grown on 13,374 acres in 1909, and on 18,838 acres, producing 33,231 tons, in 1919, according to the census. This year (1920) the acreage is larger, and an average yield of 3 tons per acre is reported. Alfalfa does well on all the soils of the county except the more sandy types, in which the lime content is insufficient for best results. It is especially adapted to the loessial uplands and the heavier terrace soils. Three cuttings are usually obtained during the season, and occasionally four cuttings. Alfalfa is generally stacked in the field and hauled to the feed lots as needed. It is used as feed for cattle and hogs. A few farmers bale a part of the hay for shipment. Hogs are often allowed to run in the fields during the summer. Cattle, however, are seldom grazed on green alfalfa on account of the danger of bloating. Alfalfa is an excellent crop for building up depleted soils, and is often used in crop rotations. It is not in favor for short rotations, as most farmers prefer to keep the stand for several seasons before changing to other crops.

The acreage of wild hay is practically the same as that of alfalfa. The Nebraska State Board of Agriculture reports an average yield of 1.2 tons per acre in 1920. Hay is cut chiefly on the sandier soils, which are unsuited to cultivated crops on account of the danger of soil drifting when the protective sod is disturbed. It is also the main crop on the poorly drained bottom soils throughout the county. Very little of the loessial upland remains in wild grasses. The bottom lands yield about twice as much hay per acre as the sandy upland soils. The quality of the upland hay is much better; it grows less rank, is finer in texture, and has a higher feeding value. The hay is stacked in the field and either baled for market or hauled to the feed lots as needed. It is used chiefly as feed for work stock.

The acreage of barley in some years is greater than that of rye. The average yields for 1918, 1919 and 1920 were 15, 29, and 21 bushels per acre, respectively. Most of the rye is grown on the moist bottom-land soils, where it does exceptionally well. The crop is cut with a binder and either shocked or stacked in the field for threshing. The grain is used as feed for cattle and hogs. The straw usually remains in the field as left by the thresher, and the cattle are allowed to feed upon the stack.

The acreage of rye varies. In 1920 it was somewhat smaller than in 1919. The average yield is about 14 bushels per acre. According to the report of the State Board of Agriculture, it was more profitable to grow rye than wheat in 1920. The market price of rye is somewhat lower, but the increased yield tends to make the profit per acre greater. The crop is grown chiefly upon the heavier soils. It is generally grown for the grain, but also to some extent for hay and pasture. It is more drought resistant than wheat and will flourish on soils of a more impoverished nature. In cutting the crop either a binder or header is used, depending upon the length of the straw. The grain is threshed from the shock or from the stack, the latter method being used when the crop is headed. Most of the rye is fed to stock on the farms, though some is sold. Many farmers plant a small patch of rye for pasture early in the fall.

Small fields of millet, emmer, kafir and other sorghums, clover, and timothy are grown by many farmers for feed. Potatoes are grown for home consumption. Watermelons and muskmelons are grown in a small way on the sandy terrace soils. They are sold mostly in St. Paul and surrounding towns.

A few small apple orchards occur throughout the county. The demand for fruit is not supplied, and it would seem that fruit production, especially on the heavier terrace soils, could be profitably extended. Trees usually do not do so well upon the uplands on account of lack of moisture, but on the terrace lands this is largely offset by the nearness of the water table to the surface. Of the wild fruits, plums and grapes are the most important. They grow chiefly along the larger streams throughout the county.

The raising of livestock is an important industry of the county, particularly cattle production. According to the census, there were 27,892 cattle in the county in January, 1920, of which more than 73 per cent were beef cattle. Most of the herds are of grade stock, headed by purebred bulls. The quality of the beef cattle in general is very good. The principal breeds are Hereford and Shorthorn. There are 111,648 acres of pasture land in the county, and many farmers purchase stock for summer grazing. Most of the cattle are shipped as feeders or stockers, though large numbers are fattened on corn, after coming off the summer range, and are shipped to Omaha.

There are no farms devoted exclusively to the dairy industry. Nearly every farmer, however, milks a few cows, chiefly of beef breeds, and sells the surplus dairy products in the local markets.

Hog raising is practiced extensively, and nearly every farmer fattens a small herd for market. The census reports 42,330 hogs in the county in January, 1920. Duroc-Jersey, Poland-China, and Hampshire are the principal breeds. A few farmers have purebred herds, though most of the animals are of grade stock. It is a common practice to fatten the hogs on corn, either feeding them in yards or turning them into the fields to "hog down" the corn in the fall. Alfalfa is often added to the ration. Many herds have been greatly reduced or entirely destroyed in the past by the prevalence of hog cholera. Much attention is now given to vaccination and sanitation in combating this disease, and its disastrous effects have been largely eliminated.

Horses of the Percheron draft type are popular in the county, the work stock showing considerable improvement during the last 10

years, from the mating of purebred stallions to grade mares. A few mules are raised. According to the census there were 9,610 horses and 711 mules on farms in the county in January, 1920.

Sheep raising receives little attention, although increased interest is being displayed in small breeding flocks. Some feeders are imported each fall, fattened on corn and pasturage, and shipped to Omaha when the market is favorable.

Poultry constitutes an important source of farm income. A small flock of chickens is raised on nearly every farm. The local demand for poultry products is usually good, and the poultry industry is receiving increased attention. The Leghorn, Plymouth Rock, Rhode Island Red, and Orpington are the principal breeds. Ducks, geese, turkeys, and guinea fowls are raised to a small extent. The report of the State Board of Agriculture shows 9,036 dozen poultry of all kinds in the county in April, 1920.

The adaptation of certain soils to particular crops is observed to some extent by the farmers. It is recognized that alfalfa is not suited to the sandy Valentine soils on account of their low lime content and unstable nature; that corn does well upon the Marshall silt loam of the uplands, but produces higher yields upon the heavier textured well-drained bottom lands; that Dunesand and the more sandy members of the Valentine series are best adapted to grazing, as there is danger of the soil blowing when the protective covering of grasses is removed; and that small grains do best upon the Marshall and Grundy silt loams. While the above crop adaptations are recognized, there is not sufficient variation in yields to cause specialized farming in any part of the county.

Systematic crop rotation is not practiced, although on many farms corn is followed by a small grain or alfalfa. When alfalfa sod is broken the land is generally used for corn 2 years, oats 1 year, wheat 1 year, and back to corn. Corn is probably better adapted to recently broken alfalfa ground than small grain on account of its deeper rooting system, but even corn is subject to drought during dry seasons, as the alfalfa plant requires considerable moisture and leaves the ground in a comparatively dry condition. Corn is often kept on the same land from 2 to 4 years, followed by 1 year of oats and 1 or 2 years of wheat. A rotation which appears to have merit consists of 2 years of corn, 1 year of oats, rye, or barley, 1 or 2 years of wheat, and 4 to 6 years of alfalfa.

Only moderate attention is given to the proper cultivation and fertilization of most of the crops. Wheat land is usually plowed in the fall just before seeding and the seed bed packed with a harrow and disk. Little time is allowed for the proper aeration and settling of the soil between plowing and seeding. The grain is usually planted with a press drill. Some wheat is drilled between the corn rows in the fall, but where small grain follows corn the land is more often plowed, disked, and harrowed before planting.

Most of the corn is listed in, a one-row lister being commonly used. This method is considered by the more progressive farmers to be inferior to surface planting or checkrowing corn. The listed crop is often severely damaged during heavy rains, especially along hillsides where entire rows are sometimes washed away, and on bottom land sediment frequently collects in the furrows and covers the small plants. The crop is cultivated three to five times. When

corn follows a crop of corn that was not cut for fodder or silage, the stalks are broken down with a stalk cutter, and the field is disked before plowing.

Alfalfa requires a smooth, mellow seed bed and is usually planted after wheat. The seed is generally sowed broadcast and harrowed in, though a few farmers prefer planting with a press drill in order to secure a more uniform stand. Alfalfa does best when sown immediately after the first good rain in August. From 12 to 15 pounds of seed per acre is considered sufficient.

Oats, rye, and barley are planted in the same manner as wheat, except that they are usually planted in the early spring as soon as possible after the frost is out of the ground.

As a rule, the farms are well improved. The houses and barns are usually painted and kept in good repair and there is a general appearance of prosperity. The farms are fenced and cross fenced, mostly with barbed wire, though many farms are inclosed with "hog-tight" woven-wire fencing. The Nebraska State Board of Agriculture reports 72 gasoline tractors in the county in 1920, but dependence is placed mainly on horses and mules. The tractors are used on the more level lands. Modern labor-saving implements are in general use, most farms being equipped with manure spreaders, grain drills, mowers, rakes, binders, riding cultivators, and disk harrows. A few also have corn binders and hay balers. Only the more expensive farm machinery is sheltered.

No commercial fertilizer is used. The barnyard manure is piled out of doors, where much of its fertilizing value is lost by leaching. The manure is hauled out in the spring or fall and generally broadcasted on land to be plowed for corn or wheat. The land in the immediate vicinity of the barnyard usually receives the largest part of the manure, especially on the tenant farms.

Farm laborers are not easily obtained. Wages<sup>1</sup> range from \$50 to \$75 a month with board and room. Day laborers received \$3 to \$4 a day, and harvest hands were paid as high as \$7 a day, during the last season (1920). Corn shuckers receive 8 to 9 cents a bushel. A few farmers hire help by the year in order to insure against lack of labor at critical periods.

According to the census, the number of farms in the county was 757 in 1880, 1,330 in 1890, 1,486 in 1900, 1,592 in 1910, and 1,523 in 1920. The percentage of the county in farms increased from 38.6 in 1880 to 96.7 in 1920. The average size of farms in 1920 is reported as 227.9 acres. The proportion of improved land in farms was 36.8 per cent in 1880; in 1910 it was 70.7 per cent, and in 1920, 68.7 per cent. The farms vary greatly in size, but most of them contain between 80 and 320 acres. According to the State report, 175,825 acres of farm land are under cultivation.

The value of all farm property, per farm, including land, buildings, machinery, and domestic animals, was \$1,682 in 1880, \$4,684 in 1890, \$4,932 in 1900, \$14,657 in 1910 and \$29,180 in 1920.

In the last 40 years the proportion of the farms operated by owners has greatly decreased. In 1880, 96.3 per cent of the total number, and in 1920 only 63.9 per cent of the farms were so operated.

---

<sup>1</sup> These wages prevailed at the time the field work was being done. At the time of going to press (1923) the wages are considerably lower.

The owners occupied 973 farms and tenants 541 farms during 1920. During the last few years most of the leases have been for only one year. Under the cash system of land rental, which is in common use, the rent varies from \$6 to about \$10 an acre for farming land. On many farms the renter is allowed the use of the pasture land without charge. On farms rented on the share system the tenant furnishes all equipment, labor, and seed, and receives from two-fifths to one-half of the crops.

The price of land ranges from \$50 to \$350 an acre. The average price for the entire county is probably about \$150 an acre. The highest priced land is in the immediate vicinity of the towns, and the lowest priced land includes the areas of Dunesand and the sandy soils of the Valentine series in the southeastern part of the county. The average price of land on the smooth upland plain is about \$225 an acre.

#### SOILS.<sup>2</sup>

The soils of Howard County have been developed in the prairie region of the United States, where the topography and the adequate moisture supply have favored a grass vegetation. It is not necessary in this report to discuss the causes for the existence of prairies in this region; it is sufficient to state that conditions were so unfavorable to tree growth that at the time of the first settlement by white men the only timber in the area consisted of narrow fringes of trees along the streams. Every type of soil in the area, with the exception of the sands, therefore, shows the influence of the grass vegetation and of weathering under the prevailing climatic conditions. By these great soil-forming agencies the original parent materials have been changed from their raw state to their present stages of development as productive soils and given certain common characteristics.

The typical soil in this county, and one that prevails over the greater part of the smooth upland, has as its most striking characteristic a dark-brown color in the surface layer due to the accumulation of large amounts of organic matter. This organic constituent, derived mainly from the decay of grass roots, consists of finely divided, well-decomposed vegetable matter, intimately mixed or combined with the mineral part of the soil. The surface soil has a fine granular structure and, over the greater part of the county, a silty texture. The greater part of the carbonates have been removed from this material. The underlying layer, which may be regarded as the upper subsoil, has a brown color and a slightly compact structure, which passes downward into a heavy, tough clay having a hard, compact structure. The structure and texture are indications of an advanced stage of weathering and are probably due to the concentration of clay washed down from the surface soil. This material is invariably found to be leached of the greater part of its carbonates and will nowhere effervesce with acid. The thickness and degree of compaction of this layer in any given locality is determined to a large extent by topography, it being thicker and more compact on

<sup>2</sup> Howard County adjoins Hall County on the south. In places the soil maps of these counties do not appear to agree on the border. The Colby fine sandy loam of Hall County is now called the Marshall fine sandy loam, shallow phase. This is due to a change in correlation resulting from a fuller knowledge of the soils of the State.

the nearly level areas and thinner and less compact on the more rolling land. The lower part of the soil section, extending from 20 to 36 inches below the surface, is lighter in texture and more friable. It is usually a light-brown or light-gray, loose, floury silty material. This lower subsoil is nearly everywhere highly calcareous within the 3-foot section.

The profile just described is present in the smooth parts of the county, where the soil has lain in its present condition undisturbed by erosion for a considerable period of time. This soil may be regarded as the mature soil of the region; that is to say, it has reached an advanced stage of development as determined by the climatic conditions. With the group which is characterized by this profile may be placed the Grundy series on the upland and the Hall series on the well-drained terraces.

Another group, which in this area includes the Marshall series, is less maturely developed than the Grundy soils. The typical surface soil is not widely different from the soils of the Grundy series in color and structure, but as a rule it is not so deep. The upper subsoil does not have the compact structure of the corresponding layer of the Grundy, but is a friable loam, silt loam, or silty clay loam, having a uniform brown color. The lower subsoil, which is reached at depths varying from 20 to 30 inches, is the parent loess little modified by weathering. It consists of a brown or light-brown friable silt loam, having in places a loose, floury structure. This lower subsoil contains a high percentage of carbonates, principally lime carbonate. In this county many of the areas of Marshall soils are eroded to such an extent that they have not reached their normal development. The dark surface soil is thin in many places and entirely absent in spots. The intermediate layer is absent in places, and the dark surface soil has formed immediately upon the light-colored, calcareous parent material.

A much younger group of soils has been developed upon recent colluvial material. These soils have accumulated large amounts of black organic matter near the surface and have the typical fine granular structure. They are underlain by smooth brown subsoils extending to depths of 3 feet or more. The subsoils are not compact and are little heavier in texture than the surface soils. They have developed under favorable conditions with respect to drainage and erosion and have been leached of the greater part of their carbonates within the 3-foot section. The Judson silt loam is the only representative of this group.

Dunesand is wind-laid sand which, by reason of its recent deposition and its porous, leachy nature, has not reached the stage of a mature soil. The material has not accumulated much organic matter, so that the surface soil is only slightly darker than the subsoil. Any carbonates originally present in this sand have been thoroughly removed so that it will nowhere effervesce with acid.

The soils have been grouped into soil series on the basis of similarity of color, subsoil, topography, drainage, and origin. A further separation of each series into types is made on the basis of texture of the surface soil. Eleven soil series are represented in the county. Twenty-seven types and phases of types are mapped, including Dunesand and Riverwash, which consist of miscellaneous materials not classed in any soil series.

With respect to the character and mode of accumulation of the parent material, the soils may be arranged in three groups: (1) The loessial soils derived from the silty material known as loess; (2) the eolian soils derived from the recent wind-laid depositions; (3) the alluvial soils or those derived from water-laid material.

The upland soils have been developed upon the loess and sand deposits. It is probable that these two kinds of material were originally uniform in their occurrence over different parts of the county. The variations in the soils derived from them have been brought about by the soil-forming processes already described. The alluvial soils had as parent material either loess or sand, or varying proportions of the two, reworked and redeposited by streams. The well-drained terrace soils tend to approach the upland soils in their most important characteristics. The soils of the first bottoms, on account of their low positions and resultant poor drainage, differ widely from the upland soils.

The loess originally covered a large part of the surface of this county. Extensive remnants of the original loess surface may be seen on the flat divides in the western part of the county. The greater part of the loess-covered area, however, is eroded, and has a more or less rolling topography. The loess in this area is coextensive with the areas of Grundy, Marshall, and Judson soils. The loess is composed very largely of silt, with a small percentage of very fine sand and some clay, which gives it a loose fine texture and floury character. The material in its unweathered state varies in color from yellow to pale yellow or light gray. Lime is present in considerable quantities and a small percentage of iron often stains the material. The Grundy silt loam represents the most advanced stage in soil formation in this county; the Marshall soils are less mature; and the Judson silt loam has been least acted upon by the soil-forming processes.

The surface soils of types of the Grundy series are dark brown to black. The upper subsoil is of a lighter brown color and slightly more compact than the surface soil. Beginning at about 20 inches and extending to 30 inches is a brown, tough, impervious clay. The lower subsoil is a yellow, pale-yellow, or gray highly calcareous silty material. The topography is flat to gently rolling. Only one type, the Grundy silt loam, is mapped in this county.

The Marshall series includes types having dark-brown surface soils and a brown or yellow-brown subsoil slightly heavier than the surface soil. The lower subsoil is usually highly calcareous. In this county the Marshall soils are not typically developed, but are represented by five variations known as phases.

The Valentine series consists of types with brown to grayish-brown surface soils. The subsoil is a light-brown to brown loose sand. The surface soils contain small amounts of organic matter and clay, which give some of them a loamy texture. Both soil and subsoil are low in lime. These soils are developed on stationary sand hills. The topography varies from dunelike to almost level. In this county only two types of this series are found, the sand and the loamy sand.

The soils of the Valentine series have been developed from accumulations of wind-blown sand similar to the Dunesand, but have now become stationary and covered with grass. The profile is immature,

the surface soil consisting of sand slightly darkened by accumulated organic matter. The subsurface layer, and in places the soil itself, may have a slightly loamy character, probably due to a small percentage of colloidal clay. This clay may have been produced by the weathering of sand grains, particularly those of feldspathic composition. The carbonate content, even in the subsoil, is too low to cause effervescence with acid.

The soils of the O'Neill series, lying on the terraces, have black organic matter in the surface soil. The upper subsoil usually has a uniform brown color and a friable structure. The lower subsoil is usually composed of sand and gravel. Because of this porous subsoil the soil section is well drained and has been leached of carbonates to depths of 3 feet or more.

The soils that occupy the flat plains and depressions of the area have been developed under conditions of restricted drainage and present a variety of characteristics. The Cass and Sarpy series have free underdrainage through gravelly subsoils, but owing to their low position the water table is quite near the surface. The Cass surface soils have accumulated large amounts of black organic matter, but the Sarpy soils are not so well supplied and have a lighter color. The Lamoure soils are weathered from recent alluvium under conditions of poor drainage, and as a result the soils are black and the subsoils gray or mottled and highly calcareous. The Scott soils occur in depressions on the flat upland and the Gannett soils in the inclosed basins of the sand hills. These soils are developed on materials washed from surrounding high land. The profiles vary according to age, position, and the character of the parent material, but all show the result of poor drainage conditions during the time of their development.

The surface soils of types of the Scott series are dark brown to almost black. The upper part of the subsoil is an ashy-gray silt loam, which passes into an olive-drab, stiff, impervious clay. The soils occur in shallow basins scattered over the upland. As these areas have no outlet, water stands over them after rains. One type, the Scott silt loam, has been mapped.

The surface soils of types of the Gannett series are dark gray. The upper subsoil is a light-brown sand, often somewhat sticky. This is underlain below 18 inches by loose incoherent sands similar to the Dunesand. These types occur in basins in the sand-hill region where drainage has been restricted. In this county two types of the series have been mapped, the sandy loam and fine sandy loam.

The Judson series comprises soils of colluvial and alluvial origin. The surface soils are dark brown to almost black, and the subsoil is brown. The subsoil is not compact, as in the case of the Grundy series, and is not as heavy in texture as the Marshall subsoil. Neither surface soil nor subsoil is highly calcareous. These types are developed on terraces and on colluvial slopes. The material is mainly recent wash from loess soils.

The Hall series consists of types with dark-brown to black surface soils, underlain by a brown, slightly compact upper subsoil, which, at a depth of 18 inches, passes abruptly into a brown com-

pact clay. Below depths of 30 inches the material is a gray or grayish-yellow silt loam or silty clay, which is highly calcareous. In soil profile this series is similar to the Grundy of the upland. The series occurs on high terraces that are at present well drained. Four types of this series have been mapped, the fine sandy loam, very fine sandy loam, silt loam, and clay loam.

The O'Neill series consists of types with dark-brown to nearly black surface soils, underlain by a light-brown subsoil resting upon a substratum of sand and gravel. Neither surface soil nor subsoil is highly calcareous. The series occupies terraces, and the topography is usually nearly level. The deeper and more loamy members of the series have a high value for general farming, but generally the types are somewhat droughty. Four types of the series have been mapped in this county.

The Cass series includes types having dark-brown to black surface soils, and a brown lighter textured subsoil, which passes within the 3-foot section into sand and gravel. Both surface soil and subsoil may be highly calcareous. The types occupy the lower stream bottoms. They are subject to overflow and as a rule are poorly drained.

The Sarpy series is similar to the Cass series in every respect except in the light color of the surface soils. Only one type, the fine sand, has been mapped in this county.

The surface soils of types of the Lamoure series are dark brown to black. The subsoil varies from grayish brown to gray or mottled gray and brown in color and as a rule is heavier in texture than the surface soil. The subsoil, and in places the surface soils, are very calcareous. These types have fair to poor drainage and are subject to flooding at intervals. Only one type, the silt loam, was mapped in this county.

Dunesand includes areas of almost pure sand, having a dunelike topography and being subject to drifting.

In the following pages the soils of Howard County are described in detail and their relation to agriculture discussed. The accompanying map shows their distribution in the county. The table below gives the actual and relative extent of the soils mapped:

*Areas of different soils.*

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Grundy silt loam.....	77,952	21.7	Gannett sandy loam.....	2,176	} 0.7
Marshall silt loam, eroded shallow phase.....	54,976	15.3	Light phase.....	448	
Valentine sand.....	50,752	14.2	Marshall very fine sandy loam, shallow phase.....	2,560	.7
Marshall silt loam, shallow phase.....	36,992	10.3	Marshall fine sandy loam, shallow phase.....	2,240	.6
Hall silt loam.....	24,832	6.9	Judson silt loam.....	2,240	.6
Marshall silt loam, flat phase.....	16,320	4.6	Lamoure silt loam.....	1,984	.6
O'Neill loamy sand.....	14,720	4.1	Gannett fine sandy loam.....	1,536	} .6
O'Neill fine sandy loam.....	14,400	4.0	Heavy phase.....	448	
Cass fine sandy loam.....	13,056	3.6	Hall clay loam.....	1,344	.4
Valentine loamy sand.....	12,608	3.5	Riverwash.....	768	.2
O'Neill fine sand.....	7,936	2.2	Sarpy fine sand.....	768	.2
O'Neill very fine sandy loam.....	6,208	1.7	Scott silt loam.....	384	.1
Dunesand.....	3,968	1.1			
Hall fine sandy loam.....	3,840	1.1			
Hall very fine sandy loam.....	3,584	1.0			
			Total.....	359,040	.....

## GRUNDY SILT LOAM.

The surface soil of the Grundy silt loam is a dark-brown to black, mellow silt loam, 8 to 12 inches deep. In the first 6 inches the soil is rich in organic matter, which gives it its dark color and mellow structure. The upper subsoil is a lighter brown, slightly more compact silt loam, which changes rather abruptly, at an average depth of 20 inches, into a yellowish-brown, tough, almost impervious clay resembling a clay hardpan. Below 30 inches the subsoil becomes a light-gray rather loose silt to silty clay which continues to great depths. The heavy layer of the subsoil is stiff and plastic when wet but becomes hard and crumbly upon drying. The subsoil varies in color from yellowish brown to yellowish drab, but is usually lighter in the lower part. In many places the heavy compact layer of the subsoil extends below the 3-foot depth, and locally the light-textured silt is encountered after passing through only 8 or 10 inches of the heavy layer, but these variations are too small in extent to warrant mapping. The type is derived through weathering of the loess, and the heavy subsoil is due to a concentration of the finer soil particles through percolation.

The Grundy silt loam is the most extensive soil type in the county. It is fairly uniform throughout the area of its occurrence and does not contain large bodies of other soils within its borders. It occupies the greater part of the western half of the county. The most typical development is probably the one between St. Paul, Farwell, and Nysted in the central part of the county.

The type occupies the highest position, occurring on nearly flat to gently undulating tablelike areas between drainage channels. The internal drainage is poor owing to the heavy nature of the subsoil, but there is usually sufficient slope to afford adequate surface drainage, and crops do not suffer from an excess of moisture.

The Grundy silt loam is the most important soil type in Howard County. Its large extent, high fertility, and level topography make it the leading soil for general farming purposes. Practically all of it is under cultivation. Wheat, corn, alfalfa, and oats are the principal crops, named in order of acreage. Rye, millet, and kafir or other grain sorghums are grown in a few small fields. Wheat is the chief cash crop and is sold at the local elevators. The raising of hogs is an important industry, but cattle feeding is not practiced extensively. Most of the corn, oats, and alfalfa is fed on the farms where produced. Grain and hay yields vary widely with the seasons and state of improvement of the land. Wheat yields range from 15 to 40 bushels per acre, with an average of about 20 bushels. The average yield of corn is about 30 bushels per acre. Oats yield 30 to 40 bushels. Alfalfa yields  $3\frac{1}{2}$  to 4 tons per acre from 3 cuttings.

The Grundy silt loam is a rather heavy soil and requires strong machinery and heavy draft animals if the largest returns are to be realized. Tractors are becoming more numerous each year, as the level topography of this type is favorable to their use.

Wheat is usually planted in the fall on double-disked corn or stubble land. Corn is usually planted in checkrows, though a few farmers prefer listing. Oats are commonly sown broadcast in April or early May. Alfalfa hay is generally stacked in the field. Com-

mercial fertilizers have never been used in growing the staple crops. Barnyard manure is applied when available. No definite system of crop rotation is practiced.

Land of the Grundy silt loam sells for \$175 to \$225 an acre, depending upon improvements and location with respect to towns.

The type is a naturally strong and fertile soil and will withstand severe cropping to one grain. It is advisable, however, to rotate crops more frequently and to bring alfalfa into the rotation as often as possible in order to maintain the present high quality of the soil.

#### MARSHALL FINE SANDY LOAM, SHALLOW PHASE.

The Marshall fine sandy loam, shallow phase, consists of a brown to dark grayish brown fine sandy loam, grading at 8 inches into a grayish-brown loose fine sandy loam, which gives way at an average depth of 12 inches to a light-gray, loose, friable very fine sandy loam. Below 30 inches the loose floury silt or silty clay of the typical loess is encountered. The surface material is rich in organic matter, and the subsoil is highly calcareous.

The soil covers a total area of 3.5 square miles. It occurs in a few small areas in the central part of the county on the south side of the North Loup River. The largest area lies about 3 miles northwest of St. Paul.

The topography varies from gently undulating to rolling. This phase usually occurs as long gently rolling slopes between the upland and the terraces. The surface in general is uneven or slightly rolling. Low rounded hummocks or knolls and intervening shallow depressions give rise to a choppy topography resembling that formed by wind in loose sand. The gentle slope, together with the porous nature of the subsoil, affords ample surface and internal drainage.

The Marshall fine sandy loam, shallow phase, is of little agricultural importance in this county on account of its small extent. It is a good farming soil, and practically all of it is under cultivation. Corn, wheat, oats, and alfalfa are the principal crops. The methods of farming are the same as those practiced on the heavier soils of the series. Crop yields are somewhat lower, with the possible exception of corn. Small grain and alfalfa do not appear to be so well adapted to this soil as to some of the heavier types.

The soil is easily maintained in good tilth and can be cultivated under a wide range of moisture conditions. The hummocky character of the surface does not seriously interfere with plowing and harvesting, but it detracts to some extent from the agricultural value of the land.

#### MARSHALL VERY FINE SANDY LOAM, SHALLOW PHASE.

The surface soil of the Marshall very fine sandy loam, shallow phase, is a brown to light-brown, loose, friable, very fine sandy loam having an average depth of about 8 inches. The depth and color of the surface soil vary considerably with the topography. On the more nearly level areas the surface soil is dark brown to brown in color at the surface and in places extends to a depth of 10 inches; on the steeper slopes, where erosion is more severe, it is seldom over 6 inches deep, and in places is light brown to grayish brown in

color. The upper subsoil is a grayish-brown, loose, very fine sandy loam to an average depth of 18 inches, below which the material gradually becomes lighter in color and heavier in texture, until at about 30 inches it grades into the loose, floury, nearly white, calcareous silt of the parent loess. The content of organic matter varies with the color, the darker colored areas containing an adequate supply and the light-colored areas being deficient in this material. The subsoil below 10 inches is highly calcareous, and the lower part contains numerous lime concretions.

This soil occurs in scattered areas varying in size from a few acres to about  $1\frac{1}{2}$  square miles in the central and northwestern parts of the county. The largest and most uniform development is a short distance northwest of St. Paul. A smaller area lies about  $1\frac{1}{2}$  miles northeast of Cotesfield. The other areas are small.

The soil has been formed partly by the weathering of loess and partly by wind-blown sands from adjoining soils. The topography is gently undulating to hilly. A large part of the soil occupies long gently rolling slopes between the upland and river valleys. Drainage is everywhere good though not excessive.

The phase is of little agricultural importance on account of its small extent. It is a good farming soil. About 90 per cent of it is under cultivation; the remainder is used for pasture and hay land. All crops common to the region can be successfully grown, with yields about the same as on the Marshall silt loam, shallow phase, and the soil is handled in the same manner.

The land sells for \$175 to \$200 an acre, depending largely upon improvements.

#### MARSHALL SILT LOAM, SHALLOW PHASE.

The surface soil of the Marshall silt loam, shallow phase, is a dark-brown to dark brownish gray mellow silt loam, from 6 to 10 inches deep. In places it contains a relatively high percentage of very fine sand. The surface is ordinarily loose in structure but becomes moderately compact if worked when wet. The surface soil passes abruptly into a grayish-brown silt loam which continues uniform to an average depth of 18 inches. Below this lies a gray or yellowish-gray silt loam, which gradually becomes lighter in color with depth, being an almost white, loose, floury silt in the lower 6-inch stratum. In the surface 6 inches the content of organic matter is high, but there is a gradual decrease in the material with depth, and below 24 inches it is almost entirely absent. The subsoil below 12 inches is highly calcareous, and lime concretions are thickly scattered throughout the lower part.

A few local variations occur. In the northern part of the county, where areas of this soil lie adjacent to areas of the Grundy silt loam, the surface soil is considerably deeper than usual, extending in places to 10 or 12 inches. In a few places along the rounded shoulders of hills and upon the crests of ridges the dark-colored surface soil has mostly been removed by erosion, leaving the white material exposed. Small areas were encountered in which the surface material contains so much sand as to approach a very fine sandy loam in texture. These variations are too small and too scattered to warrant separate mapping.

The Marshall silt loam, shallow phase, is an extensive soil. It occurs chiefly in the northern part of the county, where it is the dominant type. It occupies the broad rolling divides and slopes between stream channels. The soil is not continuous over large areas but includes numerous narrow strips of Marshall silt loam, eroded shallow phase, and large bodies of Grundy silt loam within its borders. One of the best developments of the phase occurs in the upland on both sides of Spring Creek in the northeastern part of the county. A much smaller but typical body occurs on both sides of Davis Creek in the extreme northwestern part.

The topography ranges from undulating to hilly. The phase is intermediate both in topography and position, between the flat areas of Grundy silt loam which cap the broad level divides and the badly eroded and dissected areas of Marshall silt loam, eroded shallow phase, which border the drainage ways. Drainage is good and in a few places excessive.

The Marshall silt loam, shallow phase, is one of the most valuable upland soils in the county, ranking next to the Grundy silt loam for general farming purposes. It is not so easily handled, however, as the latter type on account of its rougher topography. About 80 per cent of it is under cultivation, and the rest, which comprises only the rougher part, is used for grazing and hay production. The native vegetation consists of a luxuriant growth of grama grass, bunch grass, redtop, western wheat grass, big bluestem, little bluestem, and many other nutritious forage grasses.

Of the cultivated crops, wheat and corn are the most important, followed by alfalfa, oats, rye, and barley, ranking in acreage in the order named. Wheat is the chief cash crop. Many farmers grow wheat on the same fields continuously for periods of four to eight years. Small patches of kafir, sorghum, and millet are occasionally grown. Orchard fruits seem to bear well in favorable seasons. The yields of crops are governed largely by moisture conditions, the state of improvement of the soil, and the care used in cultivation. The general crop yields are a trifle lower than those obtained on the Grundy silt loam. Wheat yields range from 15 to 35 bushels, with an average of about 20 bushels. Turkey is the principal variety. Corn yields 20 to 60 bushels, depending upon the season, the average yield being about 30 bushels. Alfalfa yields about 4 tons per acre from three cuttings. This soil is considered somewhat better adapted to alfalfa than the Grundy silt loam on account of the looser and more friable structure of the subsoil and the higher lime content. The average yield of oats is about 25 bushels; of rye, 20 bushels; and of barley, 25 bushels per acre. Cattle are grazed on the rougher areas. Hereford is the principal breed. A few farmers feed stock for eastern markets.

The soil is handled in much the same manner as the Grundy silt loam. There are fewer tractors used on this type, however, on account of its more uneven topography. No commercial fertilizers are used, but barnyard manure is applied when available.

The selling price ranges from \$125 to \$200 an acre, depending upon improvements, topography, and distance from markets.

It is advisable to use every possible means to conserve and increase the content of organic matter and to prevent the erosion of the surface soil. In its virgin state the soil is naturally productive. Its

topography, however, is unfavorable for an accumulation of organic matter when the soil is used for crop production, and under the present system of management the areas of the eroded shallow phase are gradually increasing at the expense of this phase. Alfalfa is a very valuable crop for this soil and should be in the rotation as often as possible, as it prevents soil washing and at the same time adds nitrogen and humus. Old straw piles should be hauled and spread upon the land instead of being allowed to stand or being burned.

*Marshall silt loam, eroded shallow phase.*—The Marshall silt loam, eroded shallow phase, represents areas formerly covered by Grundy silt loam and Marshall silt loam, shallow phase, from which the surface material has been removed by erosion to such an extent that the ashy-gray, loose, calcareous silt of the unweathered loess is exposed. A very small amount of organic matter gives the shallow surface soil of this phase a darker color than is found in the subsoil. The material becomes slightly lighter in color with depth until at about 30 inches it is an almost white, loose, floury, calcareous silt.

The phase occurs extensively throughout the upland in the western and northern parts of the county, wherever stream erosion has cut into the underlying loess of the region. The areas are usually narrow elongated strips along intermittent drainage ways. A few small areas occur on the sharper peaks of hills and on the narrowest crests of the divides. The topography everywhere is steeply sloping. The slopes are usually smooth and even, but in places are badly dissected and gullied. The drainage is excessive.

About 30 per cent of the phase is under cultivation, and the remainder is used for pasture. The cultivated areas occur mostly in the western part of the county within areas of the Grundy silt loam, where the drainage channels are more shallow and the slopes less steep and gullied than in the northern part of the county.

All the crops common to the Grundy silt loam and the Marshall silt loam, shallow phase, are grown on this soil. It is impossible to give accurate yields of the various crops, however, as the soil usually comprises but a small proportion of the farms on which it occurs. Yields are considerably lower than those obtained on the surrounding types. Most of the available barnyard manure is applied to this land, as the farmers realize the soil is very low in organic matter.

It is difficult to determine land values for this soil, as it occupies a small acreage on the many farms. It has a tendency to reduce the selling price of farms where it occurs.

Alfalfa is a very valuable crop for this soil and should be planted extensively, as it adds nitrogen and humus and prevents washing, and at the same time yields good returns.

*Marshall silt loam, flat phase.*—The surface soil of the Marshall silt loam, flat phase, is a very dark brown heavy silt loam, 8 to 15 inches deep. It contains a relatively high percentage of clay which gives it a more granular structure and heavier texture than normal in the average silt loam. The soil is rich in organic matter and when wet appears black in color. The upper subsoil is a brown slightly compact silty clay, to an average depth of 24 inches. Below this the material becomes gradually lighter in color and at 36 inches it is prevailingly light brown to yellow. The structure of the typical

subsoil changes very little throughout the 3-foot section. In places, however, on the broader divides there are local spots in which the material is quite compact below 24 inches, and were these of sufficient size to warrant mapping they would be classed with the Grundy silt loam.

The subsoil is not calcareous within the 3-foot depth. Below about 40 inches, however, there is abundant lime, giving the substratum a light-gray color and loose floury texture.

The soil profile of this phase differs little from the typical Marshall silt loam as mapped in the more eastern counties of the State. Its topography, however, is more generally flat and for this reason it has been included with the flat phase of the type. It differs from the Grundy silt loam in the absence of the heavy compact subsoil and from the Marshall silt loam, shallow phase, in its more level topography, deeper and darker surface, and lower lime content.

The phase occurs as narrow elongated areas on the north side of the North Loup River. The areas occupy the more nearly level divides within the areas of Marshall soils and represent remnants of the original plain that have not been reduced by erosion. The best developments of the phase occur in T. 16 N., R. 10 W. Smaller, though quite uniform bodies lie east of Spring Creek in the north-eastern part of the county. The areas conform roughly to the direction of the drainage ways, their longer dimension extending north and south.

The phase has been derived in much the same manner as the Grundy silt loam south of the river. Drainage conditions, however, have been more favorable for surface run-off and the finer surface soil particles have not been carried into the subsoil.

The phase does not have a large total area and for this reason is not an important agricultural soil in Howard County. It is, however, one of the strongest upland soils of the area and ranks favorably with the Grundy silt loam in crop production. Practically all of it is under cultivation. The principal crops are wheat, corn, alfalfa, and oats, ranking in acreage in the order named. Rye, barley, cane, and millet are often grown in small patches for feed. Wheat is the chief cash crop. Cattle raising is not practiced extensively, although every farmer keeps a few cows to supply his dairy needs and most farmers have some dairy products for sale. Hogs are raised on every farm. They are fattened on corn and shipped to the Omaha market. The average yield of wheat is about 20 bushels, corn 30 bushels, oats 30 bushels, and alfalfa  $3\frac{1}{2}$  to 4 tons per acre from three cuttings.

The soil of this phase can be handled under a rather wide range of moisture conditions considering its heavy silty texture. When plowed wet, the land has a tendency to clod, but the lumps are easily reduced. Corn is usually listed, though a few farmers prefer to check plant. Winter wheat is grown more extensively than the spring varieties. It is usually drilled in on old corn or stubble ground after thorough plowing and harrowing. Oats are planted with a press drill as early in the spring as the condition of the soil will permit. Alfalfa seed is sown broadcast on well prepared stubble ground. The stand is usually allowed to remain 6 or 7 years before again planting the land to grain crops.

Crop rotation is not systematically practiced, although most farmers change their crops with reasonable regularity. No commercial fertilizer is used; barnyard manure is applied to the land when available.

The selling price of the Marshall silt loam, flat phase, ranges from \$150 to \$225 an acre, depending upon improvements and location.

#### VALENTINE SAND.

The Valentine sand consists of a light brownish or yellowish-brown loose sand that shows no great difference in texture or color to a depth of 3 feet. To a depth of 8 inches the soil contains a small quantity of organic matter, which gives it a slightly darker brown color. The type contains a relatively large percentage of fine and very fine sand and barely sufficient silt and clay to render the mass slightly coherent when wet. The soil differs from the Dunesand in its smoother surface and the absence, in undisturbed areas, of drifting. The sand grains are also slightly more rounded and less angular than those of the Dunesand. Neither soil nor subsoil is calcareous.

The Valentine sand is one of the most extensive soil types in Howard County. It occupies the greater part of the southeastern one-fourth of the county and extends to the edge of the terrace soils bordering the Loup and Middle Loup Rivers. A few small bodies lie west of the Middle Loup River. The type is not continuous throughout the area of its occurrence, but contains numerous areas of other soils within its borders.

The exact origin of the Valentine sand is not definitely established. It probably represents wind-blown materials from the disintegrated tertiary rocks of western Nebraska. It has been shifted by wind and water, redeposited, and subsequently weathered, and it is not possible to make any positive statement in regard to its origin.

The topography for the most part is flat to gently undulating, occasionally broken by small ridges and knolls. Drainage is entirely subterranean through loose porous sands, which afford an ample outlet for all surplus water.

Land of this type is used mainly for pasture. Probably not more than 10 per cent of it is under cultivation. It has an excellent growth of native grasses that will support 40 or 50 cattle to the quarter section during the pasture season, which ordinarily extends from April to October. The land is used as summer pasture for cattle which are either shipped in as feeders or fed on near-by farms during the winter. When cut for hay the native grasses yield from one-half to three-fourths ton per acre. Some of the more favorably situated land is farmed, especially in the lower depressions where crops can get moisture through seepage. Corn is the most important crop. Small grain does not appear to do well on account of the loose character of the seed bed. Alfalfa does fairly well under the most favorable conditions but it is extremely difficult to get a stand, and the crop seldom lasts longer than three or four years on account of the low lime content of the soil.

The type appears to withstand drought as well as the Valentine loamy sand. It is less stable, however, and blows badly when not protected by a vegetative covering. Coarse manure and straw spread

over the land have proved beneficial in preventing excessive drifting. Corn is usually deeply listed.

Land of the Valentine sand sells for \$40 to \$85 an acre, depending largely upon improvements and topography. The higher price applies to land suited to crop production.

It is doubtful if the native covering of grasses should be broken on this soil, as it is extremely difficult to prevent drifting when the land is under cultivation. Great care should be taken to keep a protective vegetative covering on the surface.

#### VALENTINE LOAMY SAND.

The surface soil of the Valentine loamy sand is a brown sand containing sufficient organic matter to give it a loamy texture. It differs from the Valentine sand only in the larger humus content of the surface soil and the resulting darker color. In a few places where conditions have especially favored the growth and decay of plant life, the surface soil to a depth of 8 inches is a dark-brown to almost black loamy sand. The subsoil beginning at an average depth of 10 inches is a light-brown to yellowish-brown, loose, incoherent sand. The type is composed of about equal proportions of fine and medium sand, with barely sufficient silt and clay to make it slightly sticky when wet.

The type is a fairly extensive soil in Howard County. It occurs chiefly in the southeastern part on the east side of the Middle Loup River. Several bodies of considerable size are on the west side of this stream. Much of the type lies within areas of Valentine sand, where it occupies the lower lying, more nearly level positions. Large bodies occur adjacent to the terrace soils throughout the southeastern part of the county. One of the largest areas occupies a narrow strip, varying in width from one-fourth mile to one and one-half miles, extending along the west side of the Middle Loup River for about 4 miles northeast from Dannebrog. A typical development occurs around St. Libory.

The original source of the sand that makes up the parent material of the Valentine loamy sand is difficult to determine. The type is derived from the same parent material as the Valentine sand and has probably been acted upon by the same agencies but for a longer period of time.

The topography is flat to gently undulating. The surface has fewer ridges and other irregularities than occur on the Valentine sand. Drainage is entirely subterranean, as the loose porous sand affords an ample outlet for all surplus water.

The Valentine loamy sand is a much better agricultural type than the Valentine sand. About 60 per cent of it is under cultivation and the remainder is used for hay and pasture. The type does not contain sufficient organic matter to prevent drifting, however, when the native covering of grasses is removed, and for this reason is not so well adapted to crop production as some of the heavier soils. A quarter section will support 50 to 60 head of cattle during the summer season, or when cut for hay will yield from 80 to 100 tons.

Of the cultivated crops, corn is the most important, followed by wheat, oats, and alfalfa. The corn is listed deeply to prevent drifting and to conserve soil moisture. Small grain is drilled in on disked

corn or stubble ground. The land is plowed every three or four years. Alfalfa is grown only to a small extent, as the land does not contain sufficient lime for the best returns from this crop. Crop yields vary greatly from year to year depending upon the rainfall. The average yield of corn is about 20 bushels per acre; wheat, 15 bushels; oats, 20 bushels, and alfalfa 2 to 2½ tons from three cuttings. No commercial fertilizer is used, but barnyard manure is applied when available.

The selling price of the Valentine loamy sand ranges from \$80 to \$125 an acre, depending upon location, topographic position, and improvements.

While the soil of this type is slightly more stable than that of the Valentine sand, it drifts badly when the protective covering of grasses is removed, unless great care is taken to use some other means of protection at all times. Large quantities of barnyard manure should prove very beneficial. It is advisable not to disturb the soil until ready to plant, as it should not be left unprotected longer than is absolutely necessary.

#### SCOTT SILT LOAM.

The surface soil of the Scott silt loam, to a depth of 6 to 15 inches, consists of a dark-brown to dark-gray heavy silt loam having a rather high content of organic matter. The soil has a slightly grayish cast when dry, in contrast with the associated Grundy silt loam. The upper part of the subsoil consists of an ashy-gray pulverulent silt loam layer, ranging from 1 to 8 inches in thickness. The lower part of the subsoil consists of a dark-drab to olive-colored, stiff, plastic, impervious clay. The change from the upper to the lower subsoil, both in texture and color, is very distinct. Small areas in which the upper subsoil is absent or occurs only as a very thin layer are included.

The type occupies small shallow depressions scattered throughout areas of Grundy silt loam. The drainage is poor, and after heavy rains in the spring water stands on the surface for periods of a few days to several weeks. The areas of this type are locally known as "buffalo wallows."

The Scott silt loam is of small extent, and the areas seldom exceed 10 acres in size. It is of practically no agricultural importance. In most places it is too wet for the successful cultivation of the staple crops and is used chiefly as pasture and hay land.

#### GANNETT SANDY LOAM.

The surface soil of the Gannett sandy loam consists of a dark-gray loamy medium to fine sand 6 to 10 inches deep. At the surface it contains an abundance of organic matter to which the dark color is due. The upper subsoil is a light-brown sandy loam which continues to an average depth of 18 inches. The lower subsoil consists of loose, incoherent gray sand marked with occasional iron stains due to poor drainage.

A few variations were noticed, especially in the subsoil, which in places changes at about 20 inches into a dark-drab, stiff, plastic, rather impervious clay. Locally the subsoil below 30 inches is a friable yellow silt. These variations occur in places where the surface is some-

what below the general level of the type, and they probably represent small exposures of an old terrace which has been largely covered with wind-blown sands. As mapped, the type includes small areas of loamy sand and fine sand soils.

The Gannett sandy loam is an inextensive type. It occurs in nearly level, poorly drained areas and small depressions in the southeastern corner of the county. One of the largest and most typical developments occurs  $2\frac{1}{2}$  miles southwest of St. Libory. A smaller though very uniform area lies south and east of this town.

The type is of minor agricultural importance. Its chief disadvantage is poor drainage. It supports a heavy growth of native grasses which afford good pasturage and give fair yields of hay. About 30 per cent of the type is farmed; corn, wheat, and oats being the principal crops. Yields are good in the drier seasons, but the land is too moist for good crop production in average years.

The selling price of the Gannett sandy loam ranges from \$75 to \$125 an acre, depending upon improvements and drainage.

*Gannett sandy loam, light phase.*—The surface soil of the Gannett sandy loam, light phase, is a dark-gray to grayish-brown sand, having a small content of silt and containing sufficient organic matter to give it a loamy structure. The depth and color of the surface soil varies with the topographic position. On the more poorly drained situations, where conditions have been most favorable for the growth and decay of plant life, the surface soil is almost black and ranges in depth from 8 to 10 inches, while on the better drained areas it is dark brown to grayish brown in color and seldom exceeds 7 inches in depth. Below 8 to 12 inches there is a subsurface layer of light-gray or pale-yellow loose sand. This is underlain by a darker colored, generally bluish-gray, more compact sand, which shows splotches of brownish iron oxide. The lower subsoil is in places slightly calcareous. It becomes moderately hard when dry, although it contains very little silt or clay. Over some parts of the phase as mapped the soil is a loamy fine sand. These areas were included with the phase, as the finer textural distinctions are of little importance in mapping a soil of this character.

This phase of the Gannett sandy loam occurs in a few small areas in the southeastern corner of the county. Its total area does not exceed 450 acres. All of it is used for pasture or hay production. Hay yields from 1 ton to  $1\frac{1}{4}$  tons per acre.

It is difficult to give land values for this soil, as it occupies only a small percentage of the farms and ranches on which it occurs.

#### GANNETT FINE SANDY LOAM.

The surface soil of the Gannett fine sandy loam is a very dark brown to black fine sandy loam to loamy fine sand having an average depth of about 8 inches. In many places, where conditions have been most favorable for plant growth and decay, the soil is spongy in structure and appreciably lighter in weight, and closely resembles Muck. On the better drained areas the organic content is much lower and the color lighter. The subsoil is a gray to grayish-brown incoherent medium to fine sand. It is relatively low in organic matter and lacks the porous compressible character that marks the surface soil in places. The subsoil material continues to great depths,

and from 4 feet downward is similar to that of the Dunesand. In the more poorly drained parts of the type, a thin layer of dark-gray or black silty clay is encountered here and there, generally below the 30-inch level. This layer is seldom over 4 inches thick. Where it occurs water usually stands for a considerable part of the year. The soil is usually faintly calcareous, but there is not sufficient lime in the subsoil to effervesce with acid.

The Gannett fine sandy loam is inextensive. It occupies poorly drained areas on the terraces bordering the Loup, Middle Loup, and North Loup Rivers, and is probably of alluvial origin, having been derived in the same manner as the soils of the O'Neill series. The largest development occurs near the eastern county line about  $1\frac{1}{2}$  miles south of the Loup River. Two much smaller areas lie about  $1\frac{1}{2}$  miles northeast of St. Paul. The other areas are of such small extent as to be of little importance.

The topography is flat. The type occupies a position somewhat lower than the surrounding country, and drainage is inadequate.

The Gannett fine sandy loam is used exclusively for pasture and hay. In average years the grasses on one acre will support a cow or steer during the summer season. When cut for hay the yield ranges from 1 ton to  $1\frac{1}{4}$  tons per acre.

A system of drainage ditches would reclaim much of this land for crop production, but it is doubtful if the increased production would warrant the expense involved. The hay could be greatly improved both in quantity and quality by adding tame grasses, particularly timothy and red clover.

*Gannett fine sandy loam, heavy phase.*—The surface soil of the Gannett fine sandy loam, heavy phase, is a dark-gray to almost black very fine sandy loam. It is generally loose and friable and contains large amounts of organic matter, and in places it has a spongy structure and light weight. At a depth of 8 to 12 inches the soil passes rather abruptly into a light grayish brown fine sand to loamy fine sand. Below 24 inches the material is a gray fine sand, which continues below the 3-foot section. Both soil and subsoil are generally wet, and the subsoil is slightly sticky when wet owing to the presence of a small amount of silt and clay.

The phase occurs in a few small poorly drained areas on the terraces bordering the Loup and North Loup Rivers. Its total area does not exceed 450 acres. It is of little agricultural importance beyond its value as grazing land. The topography is flat, and drainage is poor, water standing on the surface for a considerable time after heavy rains.

This land has no separate sale value as it occupies only a small part of the farms on which it occurs.

The table below gives the results of mechanical analyses of samples of the soil and subsoil of the typical Gannett fine sandy loam:

*Mechanical analyses of Gannett fine sandy loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
374126.....	Soil.....	0.5	3.5	5.5	56.1	13.9	12.5	7.9
374127.....	Subsoil.....	.5	5.8	7.5	61.9	12.5	5.1	6.2

## JUDSON SILT LOAM.

The surface soil of the Judson silt loam is a brown to dark-brown, loose, friable silt loam 10 to 15 inches deep. The subsoil has about the same texture, but is slightly lighter in color than the surface material, owing to a lower humus content. In a few places the subsoil is dark brown to almost black, and is slightly heavier in texture than the surface soil. In the vicinity of Elba the subsoil is light brown in color, but differs little in texture or structure from the surface soil. These variations were all included with the typical soil as they were too small in extent to warrant separate mapping.

The soil owes its position mainly to colluvial action, although in many places it has been considerably modified by alluvial deposits and resembles terrace or bench land. It is of comparatively recent origin, and sufficient time has not elapsed for the development of the light-colored compact subsoil so characteristic of the Hall series.

The type is not extensive. It occurs chiefly along the valley slopes bordering the terrace soils of the Loup, Middle Loup, and North Loup Rivers. Smaller areas lie along the stream slopes throughout the upland part of the county. Numerous areas are developed around the mouths of streams leading into the main valleys, where they occupy low colluvial or alluvial fans. One of the largest areas lies between Elba and Cotesfield, and a smaller area lies north of Cotesfield.

The topography is smooth with a decided slope toward the stream channels. The type lies from 20 to 40 feet above the normal flow of the streams and is well drained. No part of it is subject to rapid erosion.

Owing to its small extent the type is not important in the agriculture of the county. Its high content of organic matter and friable structure tend to make it drought resistant, and where it occurs more extensively it is regarded as a very valuable farming soil. It is equal to the Marshall silt loam in productiveness. Nearly all the Judson silt loam is under cultivation. Wheat, corn, oats, and alfalfa are the most important crops, wheat and corn occupying the largest acreage. Potatoes and other vegetables are grown to supply the home demand. There are no specialized crops on this type. On a few farms cattle are fed for eastern markets. Hogs are raised on nearly every farm. All farmers have some dairy and poultry products for sale.

Wheat gives an average yield of 20 bushels per acre; corn, 30 bushels; oats, 30 bushels; and alfalfa, 3 to 4 tons from three cuttings.

The Judson silt loam is somewhat easier to handle than the Marshall silt loam on account of its more nearly level topography and the absence of destructive erosion.

The type sells for \$175 to \$200 an acre, depending upon location and improvements. Its occurrence, even in small areas, on a farm has a tendency to increase the general value of the land.

On account of its small total area, not exceeding 320 acres, a fine sandy loam variation was included with the type as mapped. It differs from the typical silt loam by the presence of a larger percentage of very fine sand in the surface soil. The largest and most typical body occurs in sec. 6, T. 16 N., R. 11 W. A smaller area

lies east of Cotesfield on the east side of North Loup River. About 30 per cent of this soil is under cultivation. It compares favorably with the typical silt loam in crop production.

#### HALL FINE SANDY LOAM.

The surface soil of the Hall fine sandy loam is a dark-brown loose fine sandy loam 8 to 10 inches deep. An abundance of organic material is usually present, which gives the soil its dark color. The subsoil differs very little from that of the Hall very fine sandy loam. It becomes slightly lighter in color at 10 to 12 inches, but continues as a brown fine sandy loam containing considerable organic matter to a depth of about 18 inches, where it grades into a slightly compact very fine sandy clay of light yellowish brown color, mottled with occasional iron stains. Below 28 or 30 inches the subsoil becomes looser in structure, grading into a yellowish-gray, loose, floury silt. The soil is uniformly fine in texture, containing relatively high percentages of very fine sand and silt and only a small proportion of particles coarser than fine sand.

In a few places the subsoil differs from the typical in that it is not more compact than the surface material below 18 inches but consists of a yellowish-brown friable fine sandy clay. This passes at about 30 inches into a yellowish-gray friable sandy clay or sticky sandy loam and sand.

The Hall fine sandy loam occupies a small total area in Howard County. It occurs chiefly along the boundary in the east-central and southeastern parts of the county. A few bodies lie along the Middle Loup River in the south-central and southwestern parts. One of the most typical developments occurs in the southeastern corner. A somewhat larger though less uniform area lies around Dannebrog, in the south-central part. Smaller areas occur along the county line in Gage Valley precinct.

The type has been derived in much the same manner as the other members of the Hall series. Its larger sand content is due in part to a deposition of coarser material and in part to sands blown from the surrounding types. The topography is flat to very gently undulating. Low mounds of almost pure sand are scattered over the surface, giving it in places a hummocky appearance. Drainage is usually sufficient for crop production. In some of the lower and flatter situations, however, there is an excess of moisture in wet years. The water table is ordinarily encountered at depths of 5 to 10 feet, varying with the elevation of the surface.

Owing to its small extent the Hall fine sandy loam is not an important farming soil in Howard County. About 60 per cent is under cultivation, and the remainder used for hay and pasture land. Corn, wheat, alfalfa, and oats are the principal crops, named in order of acreage. The greater part of the grain and hay produced is sold from the farms. Crop yields show wide variation from year to year. Corn yields average 30 bushels per acre; wheat, 18 bushels; oats, 30 bushels; and alfalfa, 3 to 3½ tons.

The soil has a loose, mellow structure and is easy to work and maintain in good tilth. It is not injured by plowing immediately after rains and can be worked under almost any moisture conditions.

The selling price of the Hall fine sandy loam ranges from \$175 to \$200 an acre, depending largely upon improvements.

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

*Mechanical analyses of Hall fine sandy loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
374157.....	Soil.....	0.0	2.3	4.3	44.9	26.3	13.2	9.0
374138.....	Subsoil.....	.0	.8	.8	7.6	38.8	36.3	15.6

HALL VERY FINE SANDY LOAM.

The surface soil of the Hall very fine sandy loam consists of a very dark brown material, composed largely of very fine sand and silt, with an average depth of 8 inches. It contains only a small percentage of clay and scarcely any material coarser than fine sand. The immediate surface has a high content of organic matter and appears black when wet. The upper subsoil is slightly lighter in color, and contains a larger proportion of silt. It is not more compact than the surface soil, but is loose and friable in structure. Below an average depth of 20 inches the subsoil grades into a moderately compact, light brownish or yellowish silt to very fine sandy loam, which continues to a depth of about 30 inches. This layer is not nearly so compact as the corresponding intermediate subsoil layer of the Hall silt loam, probably owing to its larger sand content. Below 30 inches the material is a light-gray floury very fine sandy loam to silt, which contains sufficient lime to effervesce freely with acid. In a few poorly drained spots the lower subsoil is a yellowish-drab, compact, waxy clay.

In places the division line between the Hall very fine sandy loam and silt loam is rather arbitrary, as the two types gradually merge into each other. In a small area along Turkey Creek, about  $2\frac{1}{2}$  miles northeast of Dannebrog, the subsoil is but little heavier than the surface soil and consists of a loose yellowish-brown silt to very fine sandy loam, grading at about 30 inches into almost white floury silt.

The Hall very fine sandy loam is not extensive. It occurs in numerous small areas on the terraces bordering the Loup, Middle Loup, and North Loup Rivers, and in isolated areas along the boundary in the eastern and southeastern parts of the county. The areas seldom exceed 320 acres in size. One of the largest developments occurs just north of St. Paul. A very uniform area lies about one-half mile northwest of Boelus.

The type has been developed on alluvial terraces lying well above overflow. The topography is flat, though drainage is generally good, as there is sufficient slope to carry off most of the surplus water and the porous subsoil affords good internal drainage. There are a few local depressions where water stands for a considerable time, but as these places seldom exceed 3 acres in extent they do not seriously interfere with farming. None of the type is subject to erosion.

Owing to its small extent, the Hall very fine sandy loam is not an important agricultural soil. It is naturally fertile and ranks with the Hall silt loam in productiveness. About 90 per cent of it is under cultivation, and the remainder, including the poorly drained areas, is used for pasture and hay land. Wheat, corn, alfalfa, and oats are the principal crops, named in order of their acreage. The average yield of wheat is probably 20 bushels per acre; corn, 30 bushels; and of oats, 40 bushels. Alfalfa yields 3 to 3½ tons per acre from three cuttings. A fourth cutting is sometimes obtained, but most of the farmers prefer to leave the fourth crop for hog pasture.

The surface soil of the Hall very fine sandy loam is loose and loamy and can be cultivated under a wider range of moisture conditions without injury than that of the silt loam. The soil is slightly more coherent than the associated fine sandy loam, and it forms a somewhat better seed bed for wheat and oats.

The type sells for \$150 to \$200 an acre, depending upon improvements and location with respect to markets.

#### HALL SILT LOAM.

The surface soil of the Hall silt loam consists of a very dark brown to almost black heavy silt loam 8 to 10 inches deep. Usually it contains very little material coarser than very fine sand. The soil is rich in organic matter, which gives it its dark color. The upper subsoil is a somewhat lighter brown, more compact silt loam, which continues to an average depth of 18 inches, where it passes abruptly into a yellowish-brown clay, tough and plastic when wet and very hard and impenetrable when dry. At a depth of 30 inches the subsoil passes into a more friable silty clay to silt, of yellowish-gray color. The change between soil and upper subsoil is very gradual. The material below 30 inches is highly calcareous. The substratum is a pale-yellow or grayish friable silt loam and very fine sandy loam, extending to depths of 10 to 20 feet.

In a small area southwest of Farwell, along the south side of Oak Creek, the soil profile differs from the typical. The heavy subsoil layer is almost absent, and the material below an average depth of 12 inches consists of a slightly compact yellowish-brown silt to silty clay, underlain at 24 to 30 inches by a light-gray or almost white, loose, floury silt. In a few places, where the type borders areas of sandy soils, the surface material is slightly coarser in texture. Another minor variation is rather widely distributed throughout the areas of the typical Hall silt loam, occurring in shallow poorly drained depressions, from 1 to 5 acres in extent. The surface soil is somewhat more compact than the typical, the hardpan layer is slightly darker in color and more impervious, and the lower subsoil is pale yellow or olive brown and highly calcareous. Very small accumulations of alkali are encountered here and there in these areas.

The Hall silt loam occurs along all the larger drainage ways in Howard County with the exception of the Loup River, which has predominantly sandy terrace soils. It is mapped chiefly along the south side of the North Loup River. The largest area is on the high

terrace between Cotesfield and Elba. Smaller areas occur on the terraces bordering Spring, Oak, Turkey, and Deer Creeks.

The type represents old alluvial material, deposited when the streams were flowing at a higher level. The topography is flat, sloping gently toward the streams and down valleys. The surface lies from 15 to 30 feet above the first bottoms and is well drained, the slight slope being sufficient to afford ample outlet for surface waters. The soil is nowhere subject to stream erosion.

The Hall silt loam is an important agricultural soil. Nearly all of it is under cultivation, except a few poorly drained spots which are used for pasture and hay production. Corn, wheat, alfalfa, and oats are the principal crops. Barley, millet, and sorghum are grown in occasional small fields. Little livestock is kept on this type, though a few farmers are engaged in stock feeding. Very few of the farmers keep dairy herds, but most of them have some dairy products for sale.

The average yield of corn is about 28 bushels per acre; of oats, 40 bushels; and of alfalfa,  $3\frac{1}{2}$  to 4 tons from three cuttings. Alfalfa seems to give better results on this soil than on any other type in the county.

Land of this type, when handled under favorable moisture conditions, is easily worked and maintained in good tilth. If plowed when wet it has a tendency to clod, but the lumps are easily reduced. Four-horse teams and gang plows are commonly used, turning 2 furrows to a depth of 6 or 7 inches. Tractors are becoming more numerous each year.

No commercial fertilizer is used, but manure is applied when available. Crop rotation is not generally followed. The more progressive farmers rotate their crops, and frequently seed the land to alfalfa.

Land of the Hall silt loam ranges in price from \$200 to \$350 an acre, depending upon improvements and location. It is probably the highest priced land in the county, as its level topography, good drainage, and nearness to markets make it very valuable.

Below are given the results of mechanical analyses of samples of the soil, subsurface, and subsoil of the Hall silt loam:

*Mechanical analyses of Hall silt loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
374132.....	Soil.....	0.0	0.7	0.6	7.8	30.5	47.2	12.5
374133.....	Subsurface.....	.0	1.0	1.2	19.5	18.6	37.4	22.1
374134.....	Subsoil.....	.0	.1	.3	3.4	17.6	61.7	16.7

HALL CLAY LOAM.

The Hall clay loam as mapped in this county is identical with the type as mapped in Hall County on the south. It consists of 8 to 10 inches of very dark gray or black, slightly plastic and sticky clay loam, grading into a dark-drab or yellowish-drab, stiff, very fine sandy clay. In a few places a surface layer of 2 or 3 inches consists of a dark-gray or black, loose fine sandy loam or very fine sandy

loam, which rests upon a subsurface layer of plastic clay. A grayish sticky sand, underlain by coarse sand, usually saturated with water, is encountered below 30 inches. The surface soil is slightly calcareous. The subsoil contains an abundance of lime both in the finely powdered form and as concretions thickly scattered throughout the subsoil.

Small alkali spots, distinguished by the white efflorescence of salts at the surface, are common in nearly all the areas of this type. They range in extent from a few square yards to about one acre and contain an excess of salts sufficient to injure grain crops and alfalfa. Low mounds of fine and very fine sandy loam are common throughout the type, but they are too small in extent to be shown on the soil map.

The Hall clay loam occurs only in the southeastern corner of the county on the high terrace along Prairie Creek, which flows just south of the corner. The largest area lies  $2\frac{1}{2}$  miles southeast of St. Libory. A smaller area lies along the southern county line 1 mile east of the Union Pacific Railroad. A few patches, too small to be shown on the map, are distributed throughout the areas of Hall fine sandy loam. The type occupies shallow poorly drained depressions, and the most of it is used for pasture land and hay production. Some areas are farmed in connection with the more arable land.

The soil is sticky and difficult to work when wet and tends to crack, bake, and clod when very dry. In favorable years good yields of staple crops are obtained. The grasses on this type will support one cow or steer per acre during the summer season. Hay yields from three-fourths to 1 ton per acre. Where drainage is possible, the type can be made as productive as the naturally better drained soils. Thorough drainage by means of deep ditches and the use of barnyard manure are probably the best methods of treatment for the alkali spots.

It is difficult to give land values for this type, as very little of it is changing hands. It has a tendency, however, to reduce the selling price of a farm on which it occurs.

The table below gives the results of mechanical analyses of samples of the soil and subsoil of the Hall clay loam:

*Mechanical analyses of Hall clay loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
374139.....	Soil.....	0.0	0.7	0.5	4.2	39.1	35.4	20.1
374140.....	Subsoil.....	.7	1.8	1.0	3.7	25.8	39.9	27.0

O'NEILL LOAMY SAND.

The surface soil of the O'Neill loamy sand is a brown to dark-brown loose loamy sand 8 to 10 inches deep. In the first 6 inches it is considerably darker than in the lower part, owing to a slightly higher content of organic matter. The sand of which the soil is largely composed is made up of nearly all grades, but the medium and coarse sands predominate. There is usually sufficient organic

matter to give the surface soil a loamy character. The subsoil is a gray loose sand containing little or no organic matter. The change in color between the soil and subsoil is usually rather abrupt. Small angular gravel fragments are scattered throughout the soil section. Neither soil nor subsoil is calcareous.

In a few places the soil profile varies from the typical in that immediately below the surface there is an intermediate layer slightly lighter in color, which represents a gradation in color between the soil and subsoil. Locally a layer of coarse sand and fine gravel is encountered below 30 inches. Areas in which these variations occur are small and scattered and can not be shown on a map of the scale used.

The O'Neill loamy sand is one of the most extensive valley soils in Howard County. It occurs chiefly on the east and south sides of the Loup and Middle Loup Rivers, and in small areas along the North Loup River. One of the largest areas lies near the fork of the rivers. A typical area lies about 2 miles east of Dannebrog, and a large and fairly uniform area lies about 1 mile north of St. Paul.

The type is formed from terrace material deposited when the streams were flowing at higher levels.

In general the topography is flat to slightly undulating. In a few areas the surface has been modified by wind action and is hummocky. This is true of part of the area north of St. Paul. Drainage is good and in a few places excessive, owing to the open structure of the subsoil.

About 70 per cent of the type is farmed, and the rest is used for grazing and hay production. The native vegetation consists of a great variety of nutritious grasses, chief among which are big bluestem, little bluestem, sand grass, stipa, and grama grass. Of the cultivated crops, corn, wheat, alfalfa, and oats rank in acreage in the order named. The land is not so well suited to small grain as some of the heavier soils on account of its loose sandy texture.

The yields of corn range from 18 to 30 bushels, with an average of about 25 bushels per acre. Wheat yields an average of 18 bushels; oats, 20 bushels; and alfalfa,  $2\frac{1}{2}$  to 3 tons per acre. Alfalfa makes a good growth, but the stand is rarely as thick as on the Hall silt loam, or other types of the Hall series. This soil is not as durable and productive as the heavier soils of the terraces, but it is easily tilled, has adequate drainage even in wet years, and withstands drought almost as well as the heavier types. It is, however, subject to shifting by the wind, with consequent injury to young plants.

Wheat is usually planted on old corn or stubble ground, the land being disked and the grain drilled in. The land is plowed only every second or third year. Corn is usually listed in, as it withstands drought better and the young plants are not so subject to injury by the wind as when check planted.

No commercial fertilizer is used. Manure and straw are applied to the land when available, as they increase the fertility of the soil and tend to make it more stable.

The price of this land ranges from \$100 to \$125 an acre, depending upon improvements and location with respect to towns.

A coarse sandy loam variation of this type occurs in one small area of about 160 acres, lying about 3 miles southeast of Cushing. If this area had been of sufficient size it would have been mapped as a

separate type. The surface soil to a depth of 6 to 8 inches is a loose, coarse sand ranging in color from light brown to brown according to the amount of organic matter present. The subsoil consists of light-brown or gray, loose, porous sand and gravel to a depth of 3 feet or more. This soil is very droughty and has no value except as grazing land.

#### O'NEILL FINE SAND.

The surface soil of the O'Neill fine sand is a brown to light-brown loose sand 8 to 10 inches deep. It contains a moderate amount of organic matter, but not enough to prevent drifting. The subsoil is a loose, gray, almost pure sand, which extends below the 3-foot depth. Neither the soil nor subsoil is highly calcareous.

The type is not extensive. It occurs upon the terraces bordering the Loup, Middle Loup, and North Loup Rivers in small areas varying in size from a few acres to several square miles. The only large area lies along the southern county line about 5 miles east of Boelus. A smaller area lies 2 miles southeast of Cushing. The other areas are small and of little agricultural importance.

The soil has been derived in much the same manner as the other soils of the O'Neill series. Its finer texture is probably due to a larger proportion of wind-blown material scattered over the surface.

The topography is almost flat, but drainage is good and in many places excessive, owing to the porous nature of the subsoil. The type is considered too droughty to be of much agricultural importance, and the sand drifts so badly upon cultivation that most of the type has been left with its native covering of grasses. It is considered good grazing and hay land, as it supports a fairly dense growth of grasses except where grazed too closely.

Corn is the chief crop on the cultivated areas, although wheat, oats, and alfalfa are grown to a small extent. The yields are somewhat lower than those obtained on the O'Neill loamy sand.

Land values range from \$50 to \$100 an acre, depending upon the location with respect to markets.

The O'Neill fine sand should probably be left in its virgin state and used as pasture and hay land. If it is to be cultivated, however, great care should be exercised to keep the soil from drifting. Alfalfa does well on this type after a good stand is obtained. Corn should be listed in, as this aids in preventing wind erosion. Large amounts of barnyard manure and straw could be applied with beneficial results. The ground should not be left longer than is absolutely necessary without some vegetative covering for protection against the wind.

#### O'NEILL FINE SANDY LOAM.

The surface soil of the O'Neill fine sandy loam is a brown to dark-brown, loose, friable fine sandy loam 8 to 10 inches deep. It is composed largely of the finer grades of sand, with sufficient silt, clay, and organic matter to give it a loamy character. The soil passes abruptly into a subsoil consisting of loose, gray, almost pure sand containing little or no organic matter. Usually there is a considerable quantity of small pebbles throughout the subsoil, and in many places coarse sand and fine gravel are encountered below 30 inches. The sand

is largely composed of quartz grains and contains a very small amount of feldspar.

Within this type are many small areas in which the surface soil is open and loose in structure and contains a large proportion of sand approaching a loamy sand in texture. Where these areas were of sufficient size they were mapped as O'Neill loamy sand.

The type occurs quite extensively upon the terraces bordering the Loup, Middle Loup, and North Loup Rivers. It lies chiefly on the east side of the Middle Loup River. A few isolated areas occur along the eastern edge of the county south of the Loup River. One of the largest and most typical areas occurs 2 miles southeast of Dannebrog. A smaller area lies 7 miles east of St. Paul.

The type has weathered from terrace material deposited by the streams when they were flowing at a higher level.

The topography is flat to very gently undulating, with a slight slope toward the stream. Drainage is good. The loose sandy subsoil affords ample underground drainage, and the slight slope is sufficient to carry off all surplus surface water.

About 80 per cent of the type is under cultivation. Corn, wheat, alfalfa, and oats are the chief crops, named in order of their importance. The soil is better adapted to small grain than any other of the O'Neill soils occurring in this county. It is, however, not considered so well adapted to wheat as the Hall silt loam and very fine sandy loam types.

Corn yields an average of 25 bushels; wheat, 18 bushels; oats, 25 bushels; and alfalfa 3 to 3½ tons per acre. Native hay yields one-half to three-fourths ton per acre. The wheat is all sold in local elevators. Most of the corn, oats, and alfalfa is fed to cattle, hogs, and work stock on the farms where produced. Hog raising is becoming an important industry, as the land is better adapted to corn and alfalfa than to small grains.

The soil is handled in much the same manner as that of the O'Neill loamy fine sand. Much of the corn is check planted on this type, as the soil is more stable and there is little danger of blowing. Barnyard manure and straw are applied when available. The manure is usually spread over the ground in the fall or early spring.

The selling price of the O'Neill fine sandy loam ranges from \$150 to \$175 an acre, depending largely upon improvements and location.

#### O'NEILL VERY FINE SANDY LOAM.

The O'Neill very fine sandy loam consists of a brown to dark-brown, loose, friable very fine sandy loam 8 to 12 inches deep. It contains a large amount of silt and organic matter and a very small proportion of particles coarser than fine sand. The subsoil is a light-gray to gray, loose, medium to fine sand differing little from that of the O'Neill fine sandy loam. It contains little or no organic matter and is not highly calcareous. Small gravel fragments are encountered throughout the soil section and frequently occur in abundance below an average depth of 30 inches.

The type is not extensive and occurs in scattering bodies upon the terraces along the Loup, Middle Loup, and North Loup Rivers. The largest area lies about 1 mile south of Boelus, and a smaller area

occurs in the vicinity of St. Paul. The type has been derived in much the same manner as the other soils of the O'Neill series, having been developed on high terraces above the present overflow.

The topography is almost flat, sloping gently toward the stream and down the valley. Drainage is everywhere good. The slight slope and the loose porous subsoil afford ample surface and internal drainage.

About 80 per cent of the type is under cultivation, and the rest is used as pasture and hay land. The soil ranks very favorably with the Hall silt loam and Hall very fine sandy loam in corn production, though it is slightly more droughty and not so well adapted to small grain. The chief crops are corn, wheat, alfalfa, and oats. The yields average about the same as those on the O'Neill fine sandy loam.

The soil is handled in the same manner as the Hall silt loam. It is somewhat easier to till on account of its looser structure and coarser texture, and it can be cultivated under a wider range of moisture conditions. Barnyard manure and straw are the only fertilizers used on this type.

The soil of the O'Neill very fine sandy loam ranges in price from \$175 to \$300 an acre. The higher price is obtained for exceptionally well improved land in the immediate vicinity of towns.

Below are given the results of mechanical analyses of samples of the soil and subsoil of the O'Neill very fine sandy loam:

*Mechanical analyses of O'Neill very fine sandy loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
374141.....	Soil.....	0.0	0.6	0.6	9.0	40.4	39.0	10.4
374142.....	Subsoil.....	.0	2.3	9.5	79.4	6.8	1.0	1.0

#### CASS FINE SANDY LOAM.

The Cass fine sandy loam consists of a brown to dark-brown fine sandy loam 12 to 14 inches deep. The upper subsoil is a gray or grayish-brown loamy fine sand, loose in structure. The lower subsoil below 20 inches consists of a gray porous medium sand, which gradually becomes coarser with depth, changing at about 30 inches into a coarse sand and fine gravel. In the first 6 inches the soil is generally well supplied with organic matter, and it contains sufficient lime carbonate to effervesce slightly with acid. The lower subsoil is not calcareous. The principal variation in texture is toward a very fine sandy loam. In many places there is only a thin layer of surface soil, high in organic matter, underlain by yellowish-gray incoherent sand. In a few of the lower situations the dark-colored fine sandy loam is underlain at 12 to 15 inches by gray sand of medium and coarse grades.

The Cass fine sandy loam occupies the largest acreage of any of the bottom soils. It occurs in the first bottoms of the Loup, Middle Loup, and North Loup Rivers, in strips 100 yards to  $1\frac{1}{4}$  miles wide, parallel to present and to old channels. A very typical development occurs on the south side of the Middle Loup River,  $3\frac{1}{2}$  miles southeast of

Boelus. A large and uniform area lies south of Cushing, on the north side of the Loup River. A small area lies along the eastern county line in sec. 12, T. 14 N., R. 9 W.

The surface of the type ranges from level to uneven and hummocky. The greater part of it is characterized by depressions, surrounded by low sand ridges 5 to 8 feet in height or dotted by low knolls of almost pure sand. Most of the type lies 8 to 12 feet above the normal flow of the streams. Only the lowest land is subject to inundation, and this is rarely flooded. Surface drainage is usually sufficient for profitable farming, but in wet years the water table frequently comes to within 2 or 3 feet of the surface. In very dry years the underdrainage is excessive, and crops do not do so well as upon the types with heavier subsoils.

On account of its large extent, the Cass fine sandy loam is the most important bottom soil in the county. About 70 per cent of it is under cultivation, and the rest is used as pasture and for hay production. The native grasses will support 80 to 100 head of cattle per quarter section during the summer grazing season, or will yield three-fourths ton to 1½ tons per acre when cut for hay.

Of the cultivated crops, corn leads in acreage, followed by wheat, oats, and alfalfa. Corn is usually check planted, though some is planted with a lister. Small grain is generally drilled in on double-disked corn or stubble ground. Alfalfa is sown broadcast on a well-disked and smooth seed bed, and the seed worked in with a harrow. Cattle and hogs are fed on many farms, and the corn, oats, and hay crops are largely consumed on the land where produced. Corn yields vary greatly, depending upon the season. The average yield for a period of years is probably about 25 bushels per acre. Wheat yields 15 to 18 bushels; oats, 25 bushels; and alfalfa, 3 to 3½ tons from three cuttings.

Farms composed largely of Cass fine sandy loam, with average improvements, sell for about \$150 an acre.

A few areas of very fine sandy loam have been included with this type on account of their small total area and their slight variation from the type, the principal difference being that the surface soil of the very fine sandy loam contains a larger percentage of very fine sand. The soil, however, is not uniform in texture or in the relative thickness of soil horizons. Alternating layers of fine silt and clay make up the soil profile and modify the surface soil. The largest body of this soil lies about 1½ miles southwest of Cushing, on the north side of the Loup River. A smaller area lies about 3 miles north of St. Paul and several other very small areas are scattered over the bottoms of the Loup and North Loup Rivers.

#### SARPY FINE SAND.

The surface soil of the Sarpy fine sand consists of 6 to 8 inches of brown to light-brown sand containing sufficient organic matter to give it a slightly loamy character. Below 10 inches the material gradually becomes lighter in color and coarser in texture and grades into a lower subsoil of yellowish or grayish, incoherent medium sand. The color of the surface soil varies considerably with local drainage conditions. In a few places where the growth and decay of plant

life has been favored it is very dark brown to almost black. Generally there is only a small percentage of organic matter in the upper subsoil, and below 20 inches this material is almost absent. Small areas of medium sand were included with this type. In a few places within the lower lying, more poorly drained areas coarse sand and fine gravel were encountered below 30 inches.

The Sarpy fine sand occurs in a few isolated areas within the flood plains of the Loup, Middle Loup, and North Loup Rivers. The largest area lies  $1\frac{1}{2}$  miles southeast of Boelus. A very typical area lies 3 miles southwest of St. Paul on the west side of the Middle Loup River. The other areas are small.

The topography of the type ranges from flat to hummocky. The greater part is characterized by shallow depressions dotted with rounded sand hummocks 5 to 8 feet high. Drainage is generally good. The uneven surface favors ready run-off, and the porous soil and subsoil permit free underdrainage.

On account of its small extent the type is of little agricultural importance. Nearly all of it is used for pasture. About 90 per cent is cleared and now supports a fair growth of native grasses. The native forest consists of elm, ash, hackberry, cottonwood, willow, and box elder, with an undergrowth of locust and buffalo berry. The type will support 50 to 60 head of cattle per quarter section when grazed during the summer season.

Land of the Sarpy fine sand sells for \$40 to \$60 an acre, depending upon improvements and forage conditions.

#### LAMOURE SILT LOAM.

The surface soil of the Lamoure silt loam is typically a very dark brown to almost black, mellow silt loam 8 to 12 inches deep. It contains a relatively high percentage of very fine sand and in places approaches a very fine sandy loam in texture. The soil is high in organic matter and appears black when wet. The upper subsoil is slightly more compact than the surface soil and consists of a brown, heavy silt loam or silty clay loam. It is underlain at 20 to 30 inches by a grayish-brown more friable silt loam or very fine sandy loam, which continues throughout the 3-foot section. A loose porous medium sand is sometimes encountered below 32 inches. The type is generally slightly calcareous to a depth of 3 feet or more.

The Lamoure silt loam occurs in narrow strips, varying in width from 100 to 300 yards, along the first bottoms of Turkey, Oak, and Deer Creeks, in the western and southwestern parts of the county, and in small circular areas in the first bottoms along the North Loup River. The type occupies the lowest positions in the county. It is nearly level and subject to inundation during periods of heavy rainfall.

This type is used exclusively for pasture and hay. The native vegetation consists of a large variety of water-loving grasses, which yield 1 ton to  $1\frac{1}{2}$  tons per acre when cut for hay. The grasses will support one cow or steer per acre during the summer grazing season.

It is difficult to give land values for this soil, as it occupies only a small part of the farms on which it occurs.

## DUNESAND.

Dunesand consists of a grayish-brown, yellowish-brown, or brownish-gray, smooth, incoherent fine to medium sand, which extends to a depth of more than 3 feet with little change in texture. The soil contains some organic matter, but not enough to prevent drifting when the covering of grass is removed. It is unusually retentive of moisture considering its loose texture. Neither the soil nor the subsoil is highly calcareous.

The type occurs in scattering areas in the southeastern part of the county. The largest and most typical development lies 3 miles east of St. Paul on the east side of the Middle Loup River. The other bodies occur as small isolated patches lying within and surrounded by Valentine soils.

The topography of the Dunesand has been caused by wind action. The surface is sharply rolling, ridged, and heaped into dunes varying in height from 30 to 100 feet. Steep slopes abound. Numerous small hummocks, hollows, and blow-outs vary the otherwise billowy appearance of the landscape. A negligible part of the type is subject to active wind erosion at present. There are no continuous water ways through this type, but owing to the loose porous nature of the substratum all the rainfall is absorbed.

Dunesand is of no value for farming, and is used exclusively for pasture. The native vegetation includes many grasses, of which long-leaved reed grass, redfieldia, and stipa are the most common. These afford good grazing during the spring and summer, but in the winter they are killed by frost and can not be depended upon. The type is capable of maintaining 50 to 60 head of stock per section during the summer.

The selling price of the Dunesand ranges from \$50 to \$65 an acre, depending upon improvements.

## RIVERWASH.

Riverwash occurs in numerous small areas adjacent to and within the channels of the Loup, Middle Loup, and North Loup Rivers. They seldom exceed 10 acres in size and are composed of alternating sand bars, sand flats, and sand islands. The greater part of the type lies only a few feet above the normal flow of the streams and is inundated with each slight rise. Riverwash is generally not a permanent soil, the material changing with each overflow. Even during normal flow small areas are shifted about, destroyed, or added to by the varying current.

## SUMMARY.

Howard County is located in the east-central part of Nebraska. It contains 561 square miles, or 359,040 acres. About four-fifths of the county consists of upland and the remainder of terraces and first bottoms. The topography of the upland ranges from rough and hilly to almost flat, while the bottoms and terraces have a generally flat surface.

The county has an average elevation of about 1,940 feet above sea level. The general slope is toward the south and east. The drainage is effected through the Loup, Middle Loup, and North Loup

Rivers, together with their tributaries. As a whole the county is well drained.

The county was established in 1871. The first settlers were of Danish descent and came from Wisconsin. According to the census of 1920 the population of the county is 10,739, all of which is classed as rural. St. Paul, the county seat, has a population of 1,615.

The transportation facilities of the county are good, no point being more than 8 miles from a railroad. Public roads reach all farming communities. Omaha is the chief market for grain and livestock. Much of the dairy and poultry products is shipped to Grand Island.

The climate of Howard County is favorable for the production of the common staple crops, such as corn, wheat, oats, potatoes, and alfalfa. The mean annual precipitation is 26.1 inches, and the mean annual temperature is 50.5° F. The rainfall is usually quite favorably distributed. The average length of the growing season is 149 days.

The type of agriculture generally practiced consists of diversified farming, including grain farming and stock raising. The chief crops are corn, wheat, oats, alfalfa, wild hay, rye, and barley, ranking in acreage in the order named. Cattle and hogs are raised on most farms and constitute an important source of farm income. The work stock consists of medium to heavy draft horses and mules. A few tractors are used on the more level lands.

A rather indefinite system of crop rotation, subject to numerous variations, is practiced. No commercial fertilizer is used, but all the manure produced is applied to the land.

The soils of Howard County have been developed under a prairie vegetation and under climatic conditions that were favorable to the accumulation of large amounts of organic matter. The soils, therefore, which have weathered for a long time undisturbed by erosion have a dark-brown to black color. The loose drifting sands of the Dunesand and the stationary sands of the Valentine series have not developed this dark color. The soils of the county also present various differences in the soil profile due to the varying degrees of weathering, leaching, and oxidation.

On the basis of origin and mode of formation the soils of Howard County are classed into loessial soils, eolian soils, colluvial soils, and alluvial soils. The loessial materials are composed of fine-textured silts deposited over the upland part of the county during glacial times. They have given rise to the Grundy and Marshall series. The eolian materials are mostly of a sandy nature and have been blown to their present positions by northwesterly winds. These wind-blown materials have given rise to the Valentine series and Dunesand. The colluvial materials represent sediment washed down from the adjoining hillsides and deposited along the foot of slopes. They have been classed with the Judson series. The alluvial materials are composed of sediments deposited as valley terraces and flood plains by the streams. They have been included in the Hall, O'Neill, Cass, and Lamoure series, and Riverwash.

The Grundy silt loam is the most extensive and important upland soil in the county. It is adapted to all crops common to the region, but especially to corn and small grain.

The Marshall silt loam, shallow phase, ranks second in acreage among the upland soils. It is a naturally productive soil, though not so strong as the Grundy silt loam. The topography is also more hilly and the type more subject to erosion.

The Valentine sand is the most extensive type in the southeastern quarter of the county. It is not well adapted to general farming on account of its loose sandy nature and the danger of soil drifting when the protective covering of grasses is removed. Most of the type is used as pasture and hay land.

The Scott silt loam is of small extent. It occurs as small circular depressions, locally known as "buffalo wallows," throughout the upland parts of the county. The type is not used for crop production on account of poor drainage.

The Gannett soils occupy poorly drained depressions within the areas of Valentine soils and upon the more sandy terrace lands. They differ from the Scott soils in the more sandy texture and looser structure of soil and subsoil.

The Judson silt loam is inextensive. It occurs as colluvial wash upon the lower slopes bordering the terraces and flood plains. The type is rich in organic matter and highly productive.

The Hall silt loam is one of the most important and extensive terrace soils in the county. It is very productive and ranks with the Grundy silt loam in crop yields.

The O'Neill soils occur extensively on the terraces bordering the Loup Rivers. They are all of a sandy nature and are considered somewhat droughty, though excellent yields of most crops are obtained in average years.

The Cass soils occupy the first bottoms or flood plains. They are fairly well drained considering their low position, but are in places subject to frequent inundation from the streams during periods of heavy rainfall.

The Lamoure silt loam is developed in the lower parts of the first bottoms. It is subject to frequent overflow and is used mostly as hay land.

Dunesand is mapped along the Middle Loup River in the southeastern part of the county. It represents wind-blown materials derived chiefly from the river sands.

Riverwash includes sand bars and low islands in the Loup Rivers.

# Accessibility Statement

---

This document is not accessible by screen-reader software. The U.S. Department of Agriculture is committed to making its electronic and information technologies accessible to individuals with disabilities by meeting or exceeding the requirements of Section 508 of the Rehabilitation Act (29 U.S.C. 794d), as amended in 1998. Section 508 is a federal law that requires agencies to provide individuals with disabilities equal access to electronic information and data comparable to those who do not have disabilities, unless an undue burden would be imposed on the agency. The Section 508 standards are the technical requirements and criteria that are used to measure conformance within this law. More information on Section 508 and the technical standards can be found at [www.section508.gov](http://www.section508.gov).

If you require assistance or wish to report an issue related to the accessibility of any content on this website, please email [Section508@oc.usda.gov](mailto:Section508@oc.usda.gov). If applicable, please include the web address or URL and the specific problems you have encountered. You may also contact a representative from the [USDA Section 508 Coordination Team](#).

## **Nondiscrimination Statement**

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the

Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at [http://www.ascr.usda.gov/complaint\\_filing\\_cust.html](http://www.ascr.usda.gov/complaint_filing_cust.html) and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by:

- (1) mail: U.S. Department of Agriculture  
Office of the Assistant Secretary for Civil Rights  
1400 Independence Avenue, SW  
Washington, D.C. 20250-9410;
- (2) fax: (202) 690-7442; or
- (3) email: [program.intake@usda.gov](mailto:program.intake@usda.gov).

USDA is an equal opportunity provider, employer, and lender.