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SOIL SURVEY OF RENO COUNTY, KANSAS.

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The soil survey of Reno county was made by the Kansas State Agricultural College in cooperation with the Bureau of Soils, United States Department of Agriculture. The field work was done by William T. Carter, jr., F. V. Emerson, A. E. Korher and Allen L. Higgins of the United States Department of Agriculture, and Charles S. Myszlta and H. C. Lint of the Kansas Agricultural Experiment Station. The soil samples for chemical analysis were obtained and analyzed by C. O. Swanson and C. E. Millar of the Department of Chemistry, Kansas Agricultural Experiment Station. The report was written by L. E. Call and R. I. Throckmorton of the Department of Agronomy, and C. O. Swanson, all of the Kansas station. "Trees for the Sand Hills of Reno County" was written by C. A. Scott, state forester of Kansas. The mechanical analyses of the soil types were made by the Bureau of Soils, United States Department of Agriculture.

SOIL SURVEY OF RENO COUNTY, KANSAS.

DESCRIPTION OF THE AREA.

Reno county, Kansas, is situated in the south central part of the state. Its southern boundary is about fifty miles north of the Oklahoma state line. It is the third largest county in the state, having an area of 812,000 acres, or 1270 square miles.

The general topography of Reno county is that of a rolling plain intersected by three reiatively narrow valleys. The elevation varies from less than 1400 feet above sea level at its southeast corner to a little more than 1800 feet along its west side. The surface is comparatively level except in a few local areas, where it is slightly hilly. In a small area in the central-southern portion of the county there is a hilly upland.

There are four fairly distinct physiographic divisions in the county, each having distinct topographic and soil features. They are, (1) the prairie, (2) the Arkansas valley, (3) the Ninnescah and Little Arkansas valleys, and (4) the dune belt.

(1) The prairie region occupies the greatest part of the county. Its surface may be described as rolling or undulating. The drainage has not been fully established and the surface is eroded comparatively little by streams. Except near the larger valleys, the streams are short and flow in narrow valleys. In the prairie region these streams are intermittent in character, containing flowing water only after heavy rains. In the western part of the county there are areas of dune-like sandy hills. These are doubtless due to blown sand, though some appear to be due to the erosion of the original surface.

(2) The valley of the Arkansas river is from five to ten miles wide. It slopes from northwest to southeast through the northeastern part of the county. This broad trench has been occupied at different times by the constantly shifting channel of the river, and is filled to a depth of one hundred feet or more by layers of sand, gravel and clay. This material has been brought down from the Rocky Mountain region and from the area of the Great Plains.

(3) The Little Arkansas river valley extends through the extreme northeastern corner of the county from northwest to southeast. It is one to three miles wide. Like the Arkansas valley, it is a shallow trough filled with sand and clay which have been deposited from overflow waters. On the south the valley merges into the upland formed of sand dunes. These are gradually encroaching upon the valley, and in places have reached the river.

(4) The sand-hill or dune belts occupy several areas in the county. The largest extends along the northern border of the Arkansas valley in the northeastern part of the county, another lies in the extreme northwestern part of the county just south of the Arkansas valley, while other areas are found in the western part of the county on either side of the Ninnescah valley.

CLIMATE.

While the climatic conditions of Reno county are not so unfavorable as to retard greatly its agricultural development, the country lies far enough west in the region of diminished rainfall that variations from year to year exert a marked influence on crop yields.

NORMAL MONTHLY, SEASONAL, AND ANNUAL TEMPERATURES AND PRECIPITATION AT HUTCHINSON.

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.	Snow, average depth.
	Deg. F.	*Deg. F.*	*Deg. F.*	*In.*	*In.*	*In.*	*In.*
December	36	80	—14	0.0	1.9	2.6	3.9
January	33	74	—14	.6	.1	1.5	4.7
February	32	77	—24	1.4	1.2	.5	9.4
Winter	34	....	....	2.9	2.3	4.6	18.0
March	44	95	2	1.4	.2	1.8	2.4
April	57	99	23	2.4	.3	6.4	.7
May	66	100	27	3.5	2.0	3.9	....
Spring	56	....	....	7.3	2.5	12.1	3.1
June	74	105	39	4.8	3.9	5.9	....
July	78	108	50	3.8	3.5	3.2	....
August	78	107	43	2.8	1.7	5.5	....
Summer	77	....	....	11.4	9.1	14.6	....
September	70	109	30	3.0	2.1	3.5	....
October	60	95	25	2.8	.1	1.9	....
November	45	90	5	.8	.5	1.1	.3
Fall	58	....	....	6.6	2.7	6.5	.3
Year	56	109	—24	28.2	16.6	37.8	21.4

There is a considerable range of temperature. The lowest temperatures are caused by cold waves, frequently accompanied by high winds and extending over a period of several days. In summer high temperatures may prevail for several days at a time, and occasionally dry, hot winds occur.

Fall frosts severe enough to damage vegetation occur between the latter part of September and the middle of October. In the spring there is little danger of frost after the first of May. The growing season ranges from 130 to 150 days.

SOILS.

The soils of Reno county may be divided into upland and bottom soils. The upland soils may be separated into four groups: (1) those formed from shales and sandstones; (2) those formed from unconsolidated water-laid deposits; (3) those formed from a mixture of the above two groups; and (4) those formed from wind-laid deposits.

The rocks which give rise to these soils are of two classes, the bed rock and the mantle rock.

The bed rock underlies all of the country, but on most of the area it has been covered so deeply by the mantle rock that it is seldom seen. The bed rock belongs to what geologists term the Permian period, with possibly some rock of the Cretaceous period in the northern part of the county. In the southeastern part of the county the mantle rock which originally covered all the county has been washed away. It is here alone that the bed rock has furnished the material from which the soils are formed. This section is locally known as the "red jaw country" because of the color and manner of weathering of the bed rock. This rock is composed of red clay, shale, and red sandy shale interspersed with thin layers of greenish-gray shaly limestone. The soils formed from these bed-rock deposits are called residual soils.

The mantle rock is the unconsolidated material found on the surface of most of the upland of the county. These surface deposits are generally regarded as having been carried from points westward and laid down in their present positions by slow-moving streams of water that formerly flowed eastward from the Rocky Mountains. The mantle rock consists of a mixture of gravel, sand and clay in varying proportions. The gravel and larger sand particles are well rounded, indicating long-continued rolling by streams. This material covers the high rolling prairie land of the county and is called a Tertiary or sedimentary deposit. Three groups of soils have been formed by the weathering of these sedimentary deposits. They are the Pratt, the Albion and the Clark series. The Pratt series is the most extensive and is the principal group of soils of this formation. The Albion series occurs as large areas in the southern part of the country and differs from the Pratt series by having considerable fine gravel in the upper layers of the soil. This makes it more leachy and not as good agriculturally as the Pratt series. The Clark series is found along the margin of the prairie in the southern part of the county, and the subsoil contains more or less white, chalky material.

The residual soils which have been formed by the weathering of the rocks of the Red Beds do not occupy an area of over eighty square miles. The main type having this origin is the Kirkland clay. The red color of the clay, shale and red clay is so noticeable that this material is locally known as "red jaw."

In the southern part of the county are found small areas of a very fine-grained red sandstone, which on weathering gives rise to the Vernon series.

In the main area of the Red Beds there are a number of small areas of the sedimentary deposits remaining as a thin covering over the rock. This has resulted in the formation of soils combining the characteristics of the Kirkland and Pratt series. These soils were placed in the Englewood series.

The soils which owe their origin to wind-blown material have been named Smithwick series and Dunesand. In the northeastern part of the area the material has been blown onto the upland from the bed of the Arkansas river. In the western part of the county it has probably been derived from areas of the upland soils or blown in from areas farther west and south. Much of this is in the form of Dunesand.

The bottom-land soils of the Arkansas river valley have been formed by the washing of soil material from the Rocky Mountain region and from areas of sediments in western Kansas and of eastern Colorado, are mostly dark in color, and have been classified as the Arkansas series. The most recent of these deposits is still subject to overflow, and is mapped as Meadow.

The bottom-land soils of the Little Arkansas river, North

Fork of the Ninnescah, and the larger creeks of the county, have been formed more largely from the material washed from the prairie. They are lighter in color than the Arkansas series and have been mapped as the Lincoln series and Meadow.

The following table gives the classification and areas of the different soils:

CLASSIFICATION AND AREA OF SOILS.

Soil Groups and Types.	Acres.	Per cent.
Residual soils:		
Vernon very fine sandy loam	7,616	0.9
Eroded phase	64	
Kirkland clay	39,808	4.9
Eroded phase	256	
Castleton silt loam	2,944	.4
Soils from unconsolidated water-transported material:		
Pratt loamy fine sand	55,360	6.8
Pratt sandy clay loam	1,408	.1
Pratt fine sandy loam	78,080	15.1
Coarse phase	41,088	
Alkali phase	3,904	
Pratt very fine sandy loam	20,864	2.6
Pratt loam	134,976	16.6
Pratt silty clay loam	17,728	2.9
Black phase	3,968	
Alkali phase	1,728	
Albion loamy coarse sand	11,968	1.5
Albion sandy loam	89,984	11.1
Albion loam	48,384	6.0
Clark sandy loam	3,648	1.0
Coarse phase	4,672	
Clark loam	11,520	1.4
Clark clay loam	23,232	2.9
Mixed residual and sedimentary soils:		
Englewood sandy loam	2,688	0.3
Englewood loam	7,232	.9
Eolian soils:		
Smithwick fine sand	17,344	2.8
Heavy subsoil phase	5,760	
Dunesand	43,456	5.3
Alluvial soils:		
Lincoln sandy loam	6,272	.8
Lincoln very fine sandy loam	5,120	.6
Lincoln fine sandy loam	16,320	2.0
Lincoln loam	2,560	.3
Lincoln clay loam	1,536	.2
Lincoln fine sand	1,600	.2
Arkansas fine sandy loam	45,184	5.6
Arkansas loam	24,128	3.0
Arkansas clay loam	11,072	1.4
Arkansas fine sand	4,480	.6
Arkansas clay	1,152	.1
Meadow	13,696	1.7
Total	812,800	......

Vernon Series.

The Vernon series comprises the soils derived exclusively from the weathering of material of the Permian Red Beds. These soils are red to brownish-red and have red subsoils. The underlying rock is a fine-grained red sandstone. Erosion has removed only a small part of the sedimentary material from the section underlaid by this sandstone, and consequently only small areas of the soil derived from it are found. They occur over the partly eroded elevations and high points along the tributaries of the North Fork of Ninnescah river. These areas occupy an intermediate position between the high Tertiary prairie and the rather deeply carved valleys of the streams. A rolling to hilly surface is found in these areas, in places. The series has very good drainage. The Vernon very fine sandy loam is the only type of this series occurring in the county.

VERNON VERY FINE SANDY LOAM.

The surface soil of the Vernon very fine sandy loam consists of a brown, reddish-brown or dark brown very fine sandy loam twelve to eighteen inches deep. The subsoil to twenty-four inches consists of a red or reddish-brown very fine sandy loam. At twenty-four to thirty-six inches a red, fine-grained, soft sandstone is often encountered, though it may occur at a depth of several feet. The surface of this type is easily tilled, and a good surface mulch may be easily maintained. It is considered a very good soil, withstanding adverse weather conditions better than some of the heavier types.

VERNON VERY FINE SANDY LOAM, ERODED PHASE, has been formed in the same way as the typical soil except that erosion has been more active. This also accounts for the more rolling to hilly topography. Most of this type is in pasture. The soil has very little value agriculturally, owing to the thin and eroded condition of the surface.

Kirkland Series.

In the Kirkland series we have the Kirkland clay, and the Kirkland clay, eroded phase. These soils are derived from the Permian Red Beds, which consist here of interbedded red clay shale and a thin shaly limestone. This series is located in a large connected area in the southeastern part of the county and constitutes a large part of Ninnescah and Castleton townships.

KIRKLAND CLAY.

Kirkland clay consists of a brown or reddish-brown clay to a depth of six to fifteen inches. The subsoil consists of red or reddish-brown clay, very heavy and massive, that may continue to depths of thirty-six inches or may grade into red shale or a greenish-gray shaly material at from eighteen to thirty-six inches. The large area of Kirkland clay occupies a broad rolling to undulating prairie, with a few areas very rolling to hilly. A great number of small streams cut the area. The drainage is excessive and erosion has been severe.

Owing to the eroded condition and the intractable nature of the soil the type is not a desirable one. The general term of "red jaw" is applied to the red clay subsoil and to the type as a whole. Most of the land,is left in pasture, as it is difficult to cultivate. When dry it bakes into a hard, compact mass. When wet it is sticky and heavy.

The following table gives the average results of mechanical analyses of samples of the typical soil and subsoil of the Kirkland clay:

MECHANICAL ANALYSES OF KIRKLAND CLAY.

No.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
381035, 381042	Soil	0.7	3.1	2.6	3.9	8.1	41.8	39.8
381036, 381043	Subsoil	.7	2.9	2.5	4.4	4.8	47.2	37.2

THE KIRKLAND CLAY, ERODED PHASE, has a rolling to rather hilly surface. It is subject to excessive drainage and erosion. Owing to the slight extent of this phase, none of it is utilized except where it occurs in fields of the typical Kirkland clay.

Castleton Series.

CASTLETON SILT LOAM.

The Castleton silt loam is the only type of the Castleton series mapped in the county. The surface soil of this type consists of twelve inches of dark brown or grayish-brown rather heavy loam. The substratum consists of gray clay and shaly limestone, more or less disintegrated, which rests on shaly limestone at from twenty to thirty inches. Red clay occurs underneath the limestone. The Castleton silt loam is derived from the weathering of the thin, shaly limestone. It has a gently undulating to nearly level topography. The land is cultivated in some places and fair yields of corn and wheat are secured during good seasons. Owing to the impervious nature of the subsoil and the presence of the thin shaly stratum the soil has a tendency to dry out rapidly.

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

MECHANICAL ANALYSES OF CASTLETON SILT LOAM.

No.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
381045	Soil	0.8	5.1	4.0	5.0	6.3	60.7	18.1
381046	Subsoil	.5	1.8	1.1	1.8	10.0	72.9	11.7

Pratt Series.

Over a large portion of Reno county the soils are derived from the Tertiary deposits. These soils have dark-brown surface soils and yellowish-brown to reddish-brown or dark brown subsoils. These soils have been grouped in the Pratt series. They occupy the high, rolling prairie. The Pratt series is represented by a loamy fine sand, sandy clay loam, fine sandy loam, very fine sandy loam, loam, and silty clay loam.

PRATT LOAMY FINE SAND.

The Pratt loamy fine sand consists of ten to eighteen inches of a dark gray to brown loamy fine sand, underlaid by brown or yellowish-brown material of the same texture as the soil, though sometimes considerably more medium sand is present. The subsoil becomes heavier and more compact as well as lighter in color at greater depths.

The Pratt loamy fine sand is derived from the Tertiary sands of the plains region, and probably the type has been placed in its present position by wind action. During heavy minds it still drifts badly and the surface is rolling to undulating or billowy, with a dune-like topography in some places. The type is well drained. Lower-lying areas catch the run-off water and are kept moist by seepage, though as a rule they are not too wet for cultivation. A considerable portion of the Pratt loamy fine sand is cultivated, though some areas are still covered with a heavy growth of coarse prairie grass.

PRATT SANDY CLAY LOAM.

The surface soil of the Pratt sandy clay loam consists of eight to twelve inches of a dark brown sandy clay loam. The subsoil to thirty-six inches is a brown sandy clay or sandy loam. The soil of this type is derived from the weathering of

Tertiary material which has been more or less modified by wind-blown sand. The type is gently rolling and undulating and has good drainage.

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

MECHANICAL ANALYSES OF PRATT SANDY CLAY LOAM.

No.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
381070	Soil	0.1	5.3	13.9	26.6	12.2	22.6	18.9
381071	Subsoil	.2	7.0	15.4	24.0	8.6	23.3	20.7

PRATT FINE SANDY LOAM.

The Pratt fine sandy loam consists of ten to eighteen inches of dark gray to dark brown fine sandy loam underlaid to thirty-six inches by a brown loam to sandy clay. Large areas of this type are found in the northwestern part of the county, and a number of small areas in various other sections in the western part. It has been formed by the blowing of weathered Tertiary sandy material onto areas of heavier material, although it is possible that some of the type has been formed in place by the weathering of exposed Tertiary sand.

The Pratt fine sandy loam has a gently rolling to undulating surface. The type has good drainage throughout. It is cultivated extensively and is esteemed for its ease of tillage, wide adaptation to crops, and drouth resistance. The soil is splendidly adapted to vegetables and truck crops, as cowpeas, peanuts, melons and cantaloupes. Apples, pears, peaches, plums, cherries and small fruits do well. Apples are probably the surest fruit crop.

PRATT FINE SANDY LOAM, COARSE PHASE, consists of a brown to dark gray sandy loam eight to fifteen inches deep, underlain to thirty-six inches by a sandy loam to sandy clay, usually light brown. As a rule, the Pratt fine sandy loam, coarse phase, is rather a heavy loam where it occurs in the central part of the county.

In derivation, surface features, crop adaptation, yields and valuation, the phase is very similar to the typical soil.

PRATT FINE SANDY LOAM, ALKALI PHASE, has a gray fine sand or fine sandy loam to a depth of eight to ten inches. The subsoil to thirty-six inches consists of a yellow and gray mottled clay more or less sandy but very heavy. The surface of the soil is more or less white with an incrustation of alkali salt.

The alkali phase seems to have been formed from the same material as the typical soil with the addition of alkali. It is locally known as "salt flats." It exists on low, basin-like areas, formed, perhaps, by the subsidence of the surface into cavities left by dissolved salt beds. The surface sandy covering is doubtless due to the action of wind, which has blown the sand from near-by slightly higher areas,

Little of this phase is used except as pasture. It could be reclaimed by underdrainage, and would then be productive land.

The following table gives the results of mechanical analyses of the soil and subsoil of the alkali phase of the Pratt fine sandy loam:

MECHANICAL ANALYSES OF PRATT FINE SANDY LOAM, ALKALI PHASE.

No.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
3S1080	Soil	0.3	4.4	9.6	31.5	25.4	21.4	7.3
3S1081	Subsoil	.0	6.0	11.9	42.8	12.0	8.1	18.3

PRATT VERY FINE SANDY LOAM.

The surface soil of the Pratt very fine sandy loam consists of twelve to fifteen inches of medium brown or sometimes light brown very fine sandy loam, which is of rather heavy texture but of friable structure. The subsoil to thirty-six inches is usually a reddish-brown or yellowish-brown silty clay loam.

Only small areas of this soil were found. These are scattered over a considerable part of the county, but the total area is not sufficient to make it an important type. The surface is gently undulating to nearly level. The areas have fairly good drainage in most places. In the central part of the county, near Salt creek flats, a few poorly drained spots are found. Some salt grass is found here, indicating the presence of alkali.

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

MECHANICAL ANALYSES OF PRATT VERY FINE SANDY LOAM.

No.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
381072	Soil	0.0	0.5	1.2	5.2	21.2	56.9	14.6
381073	Subsoil	.0	.4	2.4	10.1	26.7	42.9	17.3

PRATT LOAM.

The Pratt loam consists of eight to fifteen inches of a heavy loam, medium-brown to dark brown in color, underlaid by a reddish-brown to dark brown clay loam or clay, which extends to depths of thirty-six inches or more. Both soil and subsoil contain a considerable proportion of silt.

The soil is easily tilled, though when wet it is somewhat adhesive, and in uncultivated fields it bakes into a rather hard and compact mass in dry weather. This soil does not drift enough to injure crops except in the highest winds and where the soil is unusually light, This type probably constitutes the most important soil in the county. It occupies the greater part of the high prairie country lying just south of Hutchinson and extending to the Permian Red Beds on the south.

This type of soil has a gently undulating to nearly level surface, being gently rolling near the larger streams. Fairly good drainage exists, the surplus surface water being carried off by small, shallow draws.

The following table gives the average results of mechanical analyses of samples of the soil and subsoil of the Pratt loam:

MECHANICAL ANALYSES OF PRATT LOAM.

No.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
381033, 381049	Soil	0.1	3.3	6.7	9.1	18.7	42.1	19.9
381034, 381050	Subsoil	.1	2.2	3.5	5.4	12.9	44.5	31.1

PRATT SILTY CLAY LOAM.

The Pratt silty clay loam consists of ten or twelve inches of a dark reddish-brown rather heavy silty loam, underlaid by a dark reddish-brown heavy silty clay loam or clay. The surface soil is nearly black when wet and contains enough clay to make it somewhat sticky.

The Pratt silty clay loam is found in a large area in the northeast corner of the county and in a number of small areas in the eastern and central parts, where it is surrounded usually by areas of the Pratt loam. It resembles greatly the latter type and differs from it only in texture.

THE PRATT SILTY CLAY LOAM, BLACK PHASE, differs from the typical soil in being darker in color and more nearly level. It is the same in derivation, and probably owes its darker color to the more moist condition existing in the flatter areas and to the wash of material from surrounding areas. It is more fertile than the typical soil.

THE PRATT SILTY CLAY LOAM, ALKALI PHASE, Consists of ten to eighteen inches of a brown to dark gray clay loam, underlaid to thirty-six inches or more by a mottled gray and brown or gray and yellow clay showing alkali spots. The surface often has two or three inches of fine sandy material on it.

This soil is found in very small, poorly drained areas in the western part of the county. The alkali present may have come from strongly impregnated beds in the original deposits, or may have accumulated through the evaporation of seepage waters draining into the depressions occupied by this soil.

The following table gives the results of mechanical analyses of samples of the typical soil and subsoil and of the black phase of the Pratt silty clay loam:

MECHANICAL ANALYSES OF PRATT SILTY CLAY LOAM.

No.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt	Clay
	Typical:	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
381022	Soil	0.1	0.1	0.5	3.5	16.1	55.5	24.0
381023	Subsoil	.2	.0	.2	1.5	10.2	50.7	[illegible]
	Black phase:							
381024	Soil	.0	.4	.7	3.1	10.4	60.4	24.7
381025	Subsoil	.0	.2	.8	6.3	13.2	40.5	39.0

Albion Series.

The Albion series occurs in the southern and southwestern parts of the county. These soils are derived from Tertiary formation.

The types of this series are characterized by dark brown surface soils and reddish-brown or brownish-red subsoils, the latter usually containing some coarse sand and fine gravel. The soils resemble the Pratt series, but the presence of fine gravel in the subsoil makes a difference that is distinctive. The agricultural value of the Albion soils is not quite so high as soils of the same class in the Pratt series. The soils mapped in this series are a loamy coarse sand, sandy loam, and loam.

ALBION LOAMY COARSE SAND.

The Albion loamy coarse sand consists of about twelve inches of dark brown loamy coarse sand, underlaid to thirty-six inches by a somewhat coarser material, ranging from a coarse sand containing some fine gravel to a bed of fine gravel. The surface soil is loose and porous, and where unprotected it drifts considerably.

The Albion loamy coarse sand has been formed by the reworking and weathering of the sedimentary material. Wind, as well as water action, has had some influence in its formation. The surface is gently undulating to slightly rolling. The surface drainage is good and the internal movement of water so free that the soil is leachy and does not retain water well.

ALBION SANDY LOAM.

The surface soil of the Albion sandy loam consists of eight to fourteen inches of a dark brown rather coarse sandy loam. The subsoil to thirty-six inches is a red to reddish-brown sandy clay containing a considerable quantity of coarse sand and fine gravel. The subsoil is sometimes very sandy and porous. The clay content of the subsoil, though relatively small, is of such a quality that it imparts a sticky nature to the mass, making it very adhesive. The surface soil is loose and easily plowed, although it clods slightly.

The Albion sandy loam has been formed by the weathering of the gravelly sandy stratum found at the base of the Tertiary deposits. Its formation has also been influenced to some extent by shifting of the material by the wind. The surface is gently undulating to rolling.

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

MECHANICAL ANALYSES OF ALBION SANDY LOAM.

No.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
381003	Soil	5.2	14.8	11.9	19.3	10.2	27.7	11.0
381004	Subsoil	10.5	16.4	10.7	20.8	10.4	15.5	15.5

ALBION LOAM.

The surface soil of the Albion loam is a dark brown, or, when wet, nearly black heavy loam. It is from ten to fourteen inches deep and often contains considerable coarse sand. The subsoil is a reddish-brown or brownish-red clay, carrying a large quantity of coarse sand or fine gravel. The soil contains enough clay to be sticky when wet, but it soon dries and can be easily cultivated.

The Albion loam has been formed by the weathering of the sandy and gravelly material of Tertiary period. The surface is gently undulating to rolling. It occupies the higher levels of the region where found, and has good drainage in most places.

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

MECHANICAL ANALYSES OF ALBION LOAM.

No.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
381001	Soil	2.2	10.0	8.6	14.1	10.7	33.2	20.8
381002	Subsoil	2.7	14.9	11.1	15.8	9.5	16.7	29.4

Clark Series.

The Clark series includes three types—clay loam, loam, and sandy loam. The surface soils are dark-colored and the subsoils grayish. The surface soil and subsoil are high in lime, and the latter contains more or less soft white calcareous chalky material and calcareous concretions. These soils are found usually along the margin of the prairie, where the streams have carved their valleys in the southern part of the county. They seem to be derived from calcareous Tertiary material, though very frequently there seems to be some association between it and the Permian formation, which is found exposed lower on the slopes.

CLARK SANDY LOAM.

The surface soil of the Clark sandy loam consists of ten to fifteen inches of a dark brown fine sandy loam, containing considerable medium and some coarse sand. The subsoil to a depth of thirty-six inches or more consists of a friable gray sandy clay, containing a large proportion of calcareous concretions, grading at thirty inches into a soft calcareous mass.

Small areas of this type exist in the western part of the county, mostly in Sylvia and Plevna townships. The surface is undulating to nearly level, but drainage is efficient throughout.

THE CLARK SANDY LOAM, COARSE PHASE, occupies but a few small areas in the southwestern part of the county, mainly in Arlington and Langdon townships. It has been derived, in part, from the weathering of the underlying calcareous material, which is probably identical with the Mortar Beds of the Tertiary in areas farther west. The surface soil has undoubtedly been formed by the drifting of sandy material from the adjacent areas of the sandy soils.

MECHANICAL ANALYSES OF CLARK SANDY LOAM.

No.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
381091	Soil	1.2	12.5	17.0	35.0	14.9	11.3	7.9
381092	Subsoil	1.0	6.1	9.5	19.9	14.3	28.9	20.3

CLARK LOAM.

The surface soil of the Clark loam is a dark brown to black loam, quite heavy and sticky in places; in others containing considerable sandy material. It ranges in depth from six to fifteen inches, with an average depth of about twelve inches. The subsoil consists of a gray sandy clay to sandy loam, very calcareous, and grading into a bed of soft chalky material. Occasionally on slopes the soil has been washed away and the white chalky material is exposed.

This type Occurs in small areas in the south-,central part of the county, chiefly in Langdon, Arlington and Roscoe townships. It has a gently rolling to undulating topography and good tilth.

MECHANICAL ANALYSES OF CLARK LOAM.

No.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
381009	Soil	0.3	6.3	13.1	24 2	13.9	23.2	18.7
381010	Subsoil	1.1	2.6	6.2	33.3	8.7	20.2	27.7

CLARK CLAY LOAM.

The Clark clay loam is composed of a dark brown or black clay loam surface soil, with an average depth of ten to twelve inches, underlaid by a subsoil of gray calcareous clay containing a great deal of soft white chalky material and lime nodules. At a depth of three or four feet, or sometimes less, the subsoil grades into a white calcareous mass. The surface soil of this type is heavy, being sticky when wet and packing hard when dry. If cultivated when in the proper condition as regards moisture, it has excellent tilth.

The main areas of the Clark clay loam are found throughout the southern part of the county, the largest lying a few miles south of Haven. It has been formed by the weathering of the white calcareous material that seems to be similar to the Mortar Beds formation found farther west.

The surface is undulating to nearly level in all but a few places, where it is somewhat rolling. In some large areas the surface is so flat that drainage is poor. However, because of the light rainfall, the land is not too wet for cultivation.

MECHANICAL ANALYSES OF CLARK CLAY LOAM.

No.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
381007	Soil	0.2	3.9	8.4	19.9	11.5	32.1	23.8
381008	Subsoil	1.4	8.7	13.9	22.0	8.8	22.3	22.7

Englewood Series.

The Englewood series of soils has been formed by the weathering of two geological formations: (1) the unconsolidated material of the Tertiary; and (2) the Permian Red Beds, which are made up for the most part of shales and sandstones. The soils range in color from brown or dark brown to reddish-brown, while the subsoils are reddish-brown to red. A large portion of southeastern Reno county is occupied by these soils. Owing to Severe erosion these types are often thin and of no great productiveness. Two types were mapped in this series — the sandy loam and loam.

ENGLEWOOD SANDY LOAM.

The surface soil of the Englewood sandy loam consists of eight to fifteen inches of a brown sandy loam. It is rather open in structure, the coarse soil grains predominating. The subsoil to thirty-six inches ranges in texture from a sandy loam to a sandy clay. The red clay of the Permian Red Beds is sometimes encountered at eighteen to thirty inches, or it may be several feet below the surface.

The soil of the Englewood sandy loam represents the remains of the original rock mantle or Tertiary material, while the subsoil may be the same material or may be the red clay of the Permian.

The surface of this type is gently rolling to undulating, and the drainage is good.

ENGLEWOOD LOAM.

The surface soil of the Englewood loam consists of eight to fifteen inches of dark brown or reddish-brown loam. Sometimes there is considerable sand in the soil, but there is sufficient clay to give a heavy texture. The subsoil to thirty-six inches consists of a neutral brown or reddish-brown loam or red clay. The subsoil of red clay may be encountered at from six to thirty-six inches, or it may form a part of the deeper stratum. The soil is easily cultivated and has good tilth, though it often contains very little organic matter.

The areas of the Englewood loam are not large and are scattered throughout the southeastern part of the county. Some areas of the type are found extending up into the high Tertiary covering, and in these places the subsoil is red clay.

The Englewood loam is gently rolling in topography and has good drainage. It occupies the higher positions where surrounded by the Kirkland clay. It often occurs as ridges and minor elevations.

Smithwick Series.

The Smithwick series of soils includes those types of unquestioned wind-blown origin, excepting Dunesand. These soils are light in color and very sandy. This type developed in two phases, as shown in the accompanying map.

SMITHWICK FINE SAND.

The Smithwick fine sand consists of eight to fifteen inches of gray to light brown fine sand, underlaid by a subsoil of yellow to brown fine sand, The sand extends from a depth of three feet to as much as twenty-five feet or more. The principal difference between this soil and Dunesand is in topography, and the separation of the two is rather general.

The soil is loose and light in structure. It occurs in one long area, extending from northwest to southeast along the upland just at the edge of and following the Arkansas valley. This soil has been formed by the blowing of river-washed sand from the bed of the Arkansas onto the upland. Over much of the area this forms a rather shallow covering over the Tertiary clays, but usually it is several feet deep.

The surface of the soil is rolling to gently rolling, and sometimes undulating. The soil has excellent drainage. A number of small draws extend through it to the area of Dunesand lying farther back on the upland, where small springs seep out giving a constant flow of water.

SMITHWICK FINE SAND, HEAVY SUBSOIL PHASE, in origin is identical with the typical soil and with Dunesand, the only difference being in the depth of eolian deposits, which is much shallower in the heavy subsoil phase.

Dunesand.

There are two large areas of the Dunesand in Reno county: one in the northeastern part of the county just north of Hutchinson, occupying a considerable part of the region lying between the Arkansas and the Little Arkansas river valleys; and the other in the northwestern part of the county just south of the Arkansas river valley. There are also a few smaller areas in the western part of the county.

From the position of the large area just north of the Arkansas river valley it would seem that this sand once formed the sandy deposits of the river bed and was blown out upon the higher areas of the upland, The other areas of Dunesand doubtless represent wind-blown sand derived from the Tertiary deposits.

The Dunesand lies on the rolling prairie in the highest parts of the county, The dunes for the most part range from five to fifteen or twenty feet in height, though some are higher. Between the dunes there are many small, flat, marshy areas that remain wet for long periods, not only on account of standing rain water, but on account of seepage from the surrounding dunes. The underlying Tertiary material of heavy gray or mottled clay is found only a few feet below the surface in these low places.

The Dunesand is rarely cultivated. The land is used principally for grazing, though the grasses are coarse and not of greatest feeding value.

Arkansas Series.

The soils of the Arkansas valley have been grouped in the Arkansas series. They are alluvial in origin, though lying at present above overflow. They are dark brown to black in color and are composed of materials brought down by the Arkansas river from the Tertiary prairies of western Kansas and Colorado. These soils are all underlaid by beds of sand and gravel at a depth of a few feet. The texture of the soils varies from sandy loam to clay, the fine sandy loam and loam being the most important and together constituting the greater party of the river valley.

ARKANSAS FINE SAND.

The surface soil of the Arkansas fine sand consists of twelve to eighteen inches of a gray to light brown fine sand. The soil is variable in texture, and sometimes considerable silt is mixed with the fine sand. The subsoil to a depth of thirty inches and more is a yellow or brown fine sand.

The Arkansas fine sand is not a very extensive type in the county. It is found in the Arkansas valley, usually in a narrow strip adjacent to the river. In the soil of this area there is considerable small gravel and coarse sand, but fine material predominates. The surface of the Arkansas fine sand is nearly level to gently undulating, with a few small areas rather dunelike.

The Arkansas fine sand drifts badly in heavy winds, where the surface is not protected by vegetation or windbreaks. This type is practically free from harmful amounts of alkali, and its main deficiency is its tendency to drift. Care should be taken to protect the soil in every way.

ARKANSAS FINE SANDY LOAM.

Usually the surface soil of the Arkansas fine sandy loam consists of a dark brown fine sandy loam twelve to eighteen inches deep. The subsoil consists of material ranging from a fine sandy loam to a sandy clay, the color being some shade of brown, often a yellowish-brown. At thirty to thirty-six inches the subsoil usually becomes a yellow or light brown fine sand.

Throughout the main valley of the Arkansas river the Arkansas fine sandy loam usually occupies second or third terraces, above overflow. The topography is nearly level to gently undulating. The type has good drainage throughout most of its extent, though some areas are so level that some water remains on the surface after heavy rains. Such places would be improved by ditching.

The Arkansas fine sandy loam is practically free from harmful quantities of alkali, though occasionally small spots may be seen that show evidence of small accumulations. The type is considered very good for the production of a number of crops, and throughout the area is largely used for farming. The soil withstands drouth well. It is rententive of the moisture falling as rain, and the water table lies only a few feet below and doubtless within capillary reach of the surface.

ARKANSAS LOAM.

The Arkansas loam is a dark brown to black loam of varying texture, eight to fifteen inches deep, underlaid by loam to clay loam, brown in color and very compact, becoming lighter in color and texture below and changing at thirty to thirty-six inches to yellow or light brown fine sand or fine sandy loam. Over the surface of the Arkansas loam are found small spots of light-colored soil, locally termed “alkali spots.” These spots are a few feet across and occupy slightly lower positions than the general surface level. The soil on these spots is a silty loam or clay loam a few inches deep, underlaid by heavy brown clay or clay loam. These spots are bare of vegetation except for a scant growth of salt grass.

The surface soil of the Arkansas loam bakes into a rather compact mass when dry, but if cultivated when moisture conditions are favorable it forms an excellent tilth. It clods slightly, but the clods are easily broken down by tillage.

Relatively large areas in the Arkansas valley are composed of Arkansas loam. Areas of this type occupy high second and third terraces above the Arkansas river.

The following table gives the results of mechanical analyses of samples of the soil, subsoil and lower subsoil of the Arkansas loam:

MECHANICAL ANALYSES OF ARKANSAS LOAM.

No.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
381028	Soil	0.2	3.1	6.4	18.5	21.5	31.5	18.4
381029	Subsoil	.2	2.7	4.2	13.8	21.7	38.7	17.7
381030	Lower subsoil	1.9	9.3	12.7	16.5	14.7	28.9	15.2

ARKANSAS CLAY LOAM.

The Arkansas clay loam is a variable type. Typically, it consists of six to twelve inches of dark brown clay loam, resting on a subsoil of grayish-brown or dark brown heavy clay, which often contains considerable sand, though it is very compact and impervious. Over much of the type the immlediate surface soil consists of four to five inches of a silty or very fine sandy loam, underlaid by the heavy clay subsoil. This type contains a high per cent of alkali and in many places the surface soil is covered with a whitish alkali incrustation.

Just north of Haven the surface soil consists of fourteen inches of a dark clay loam, underlaid to thirty-six inches by a yellow loamy fine sand, occasionally mottled with yellow and gray clay. The type packs very hard when dry, and when wet it is very heavy, and under these extremes of moisture conditions it is difficult to work and is locally known as "gumbo."

It seems probable that the alkali condition of the Arkansas clay loam is due to the evaporation of the water accumulation from time to time in depressions. At any rate, the salts in the soil are sufficiently concentrated to prevent the growth of any vegetation except a grass, locally caled "salt grass."

The following table gives the results of mechanical analyses of samples of soil, subsoil and lower subsoil of the Arkansas clay loam:

MECHANICAL ANALYSES OF ARKANSAS CLAY LOAM.

No.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
381015	Soil	0.3	2.0	4.9	14.7	18.4	38.8	20.9
381016	Subsoil	.8	2.0	3.9	13.9	19.4	32.5	27.8
381017	Lower subsoil	.6	2.7	5.3	20.1	18.3	28.9	24.0

ARKANSAS CLAY.

The Arkansas clay consists of a very dark gray to black, extremely heavy and tenacious clay, eight to twelve inches deep, underlaid by a dark gray or drab clay, very tenacious and heavy and sometimes slightly mottled with red or brown streaks. This clay subsoil may extend to a depth of thirty-six inches, or it may be entirely absent, the surface soil resting on a bed of brown sand at varying depths below eight or ten inches. The soil of the Arkansas clay is extremely heavy and is difficult to cultivate, except when moisture conditions are just right. When wet it is very adhesive, and if plowed when in this condition it bakes into a mass of hard clods which are subsequently broken down with great difficulty. When dry it bakes into a hard, compact condition and can hardly be plowed at all. If cultivated when not too wet or too dry it breaks down into a fairly friable structure.

The Arkansas clay is found in only two bodies, having a total area of about two square miles in the extreme northwestern corner of Reno county. The area which this type occupies has much the appearance of an old lake bed. It is almost level and the basin-like depressions are surrounded by higher sandy soil.

Lincoln Series.

All bottom-land soils of Reno county, with the exception of the Arkansas series and Meadow, have been placed in the Lincoln series. The soils of this series are typically of a brown color and are not underlaid with coarse sand or fine gravel as are the soils of the Arkansas series.

The soils of this series occur in the valleys of the Little Arkansas river and the North Fork of Ninnescah river, and the larger creeks of the county. The Lincoln series has the following types in this county: sandy loam, very fine sandy loam, fine sandy loam, fine sand, loam, and clay loam.

LINCOLN SANDY LOAM.

The Lincoln sandy loam is a type of variable texture. Usually the surface consists of a dark brown or dark gray sandy loam soil to a depth of twelve or fifteen inches. It is light and loose in character and contains little fine material, often bordering on loamy sand. The subsoil ranges from a loamy coarse sand to a heavy sandy loam, usually light brown in color, though sometimes mottled gray and yellow and in texture a sandy clay.

The type is found only in a few small areas as bottoms along small creeks in the southwestern part of the county. These valleys are only a few hundred yards to one-half mile in width.

The Lincoln sandy loam has been formed by the deposition of the coarser material washed from the upland soils of the Pratt and Albion series.

Areas of this type are level except in the narrow bottoms, where the surface soil often extends in a gentle slope to the upland. The streams have cut their channels several feet below the surface of these bottoms, and the type is not subject to frequent overflows.

LINCOLN VERY FINE SANDY LOAM.

The Lincoln very fine sandy loam consists of twelve to twenty inches of dark brown very fine sandy loam, resting on a brown or yellowish very fine sandy loam, which grades at thirty inches into fine sand. The surface soil is loose and light, though in many places a relatively high percentage of silt gives it the compact structure of a loam.

The soil is located in Salt creek valley and extends a short distance into the Arkansas valley where these valleys join.

The Lincoln very fine sandy loam has a nearly level to sometimes basin-like topography. In some places the drainage is rather poor, and throughout the greater part of its area only moderately good drainage exists.

LINCOLN FINE SANDY LOAM.

The texture of Lincoln fine sandy loam ranges from a fine sandy loam to loamy fine sand. Typically, the surface soil is a dark gray or brown fine sandy loam twelve to eighteen inches deep. The subsoil to thirty-six inches consists of a brown to yellowish material, ranging in texture from a fine sandy loam to sandy clay.

Areas of the Lincoln fine sandy loam are found in the narrow valleys lying along the Little Arkansas river and the north fork of Ninnescah river. Its extent is not large. The type has level surface and lies from four to ten feet above the stream beds. Overflows are infrequent, though they sometimes occur. Practically no instance exists where alkali appears in harmful quantities.

LINCOLN FINE SAND.

The Lincoln fine sand consists of twelve to fifteen inches of a gray to light brown fine sand, underlaid to a depth of several feet by a yellow or brown fine sand. The soil and subsoil are very light and incoherent.

This type is of very slight extent, being found in only a few small areas in the narrow valleys along the North Fork of Ninnescah and Little Arkansas valleys.

The surface of these small areas is gently undulating, though in a few places small dune-like areas have been formed by the action of the wind. The lower-lying areas are sometimes overflowed during floods along the Ninnescah river.

LINCOLN LOAM.

The Lincoln loam is a dark brown to black loam from eight to fifteen inches in depth, resting on a brown loam or clay loam which extends to a depth of thirty-six inches or more. The surface soil is rather compact when dry, but is easily put in good tilth if cultivated when moisture conditions are favorable.

Only small areas of this type are found. These are in the western part of the county in the Ninnescah valley, and in the northeastern part along the Little Arkansas river and some other small streams. It is a bottom-land soil and is subject to overflow at times, but not so frequently as to prevent cultivation.

LINCOLN CLAY LOAM.

The Lincoln clay loam consists of a dark brown clay loam, six to twelve inches deep, underlaid by a grayish-brown to dark brown heavy clay. Over considerable areas the surface soil consists of several inches of compact silty or fine sandy loam, and sometimes the clay of the subsoil is found at the surface. The soil packs into a hard mass when dry, and is very tenacious and heavy when wet. It is therefore a difficult soil to work. It has the local name of "gumbo."

This is a bottom-land soil, and the areas are low, flat and poorly drained, though most of the type can be cultivated even during rather wet seasons. The surface soil usually shows alkali incrustations,

Meadow.

Some areas of bottom soils in Reno county have such a variable texture that they could not be mapped on any definite textural basis. These are shown in the map as Meadow. The areas of Meadow are small, forming narrow strips along streams. The areas mapped along the Arkansas river differ somewhat from those along the smaller streams of the county.

The Meadow of the Arkansas river consists of sand banks and bars along the stream, intermingled with small areas of finer soil material. The soil in places consists of a gray silt loam to silty clay of varying depths, ranging from two inches to sixteen inches, and underlaid always by the river-washed sand. These areas are subject to overflow, and though lying four to six feet above the river bed, and having fair drainage, the water readily inundates the land during overflows.

The surface is practically level, and has in some places further from the river a basin-like topography. It is marked by a number of old channels and sloughs.

The Meadow along the smaller streams is found in the southwestern part of the county on Silver creek and the North Fork of Ninnescah river. The soil here consists of dark sand and sandy loam, often in a rather marshy conditon. It occurs in narrow strips one-fourth to one-half mile wide. It is flat and poorly drained, and lies only three or four feet above the creek beds. They are covered with a heavy growth of coarse water-loving grasses, and are used mainly for grazing, though the less marshy areas supplly considerable hay. The land is subject to overflow every year, and no crops are planted.

CHEMICAL ANALYSES OF SOIL TYPES IN RENO COUNTY.

The complete report of the chemical analyses of the soil types of Reno county is given in the table in the Appendix. This table gives the location of the point from which each sample was taken, the type name as given in the soil survey, and the percentages of the elements determined in the different types. These percentages are averaged for the different classes of types on the basis of physical texture, such as clays, loams and sands. The following table gives the pounds of plant food per acre in the surface soil, calculated from the average composition of the different types classified on the basis of physical texture.

AVERAGE NUMBER OF POUNDS PER ACRE IN SURFACE SOILS (7 INCHES) CLASSIFIED ON BASIS OF PHYSICAL TEXTURE.—RENO COUNTY.

TYPE OF SOIL.	Nitrogen.	Phos-phorus.	Potas-sium.	Calcium.	Carbon.
Clay	3,040	800	43,200	23,800	30,400
Clay loam	3,120	740	38,800	14,400	33,800
Silty clay loam	2,700	780	39,000	13,400	30,200
Sandy clay loam	2,960	800	38,200	10,000	28,600
Loam	2,740	740	41,800	13,200	28,600
Sandy loam	1,940	640	40,000	25,200	20,200
Fine sandy loam	1,600	700	44,400	17,600	16,000
Very fine sandy loam	2,200	680	41,600	10,800	24,200
Loamy fine sand	640	340	48,400	6,000	5,400
Loamy coarse sand	1,080	320	46,600	4,200	11,400
Fine sand	1,340	560	44,000	12,800	34,200
Sand (dune)	340	360	40,400	7,200	4,400
Meadow	2,080	1,400	43,600	50,800	23,000

THE NITROGEN CONTENT.

The nitrogen content of all of the soil types in Reno county averages .106 per cent for the surface soil, .076 per cent for the subsurface, and .045 per cent for the subsoil. Calculated to pounds per acre for the various depths this gives 2012 pounds for the surface seven inches, 3040 pounds for the subsurface thirteen inches, and 2700 pounds for the twenty inches of subsoil. In this average are included soils of extreme nature and composition, such as Kirkland clay with 4010 pounds of nitrogen in the surface soil, and the Dunesand with only 340 pounds per acre to the same depth.

The clays, clay loams, silty clay loams, and loams, as soil classes, average much higher in nitrogen than the loamy sands and the sands. Some exceptions in the case of the latter are found in soils where the sample was taken in a native meadow or pasture.

NITROGEN IN FRESH ORGANIC MATTER MOST VALUABLE.

As nitrogen is useful to plants only when converted into soluble forms by bacterial action, and as bacterial activity is confined mostly to the surface soil, the nitrogen in the top layer is of the most importance. The organic matter in the surface soil has resulted from the more recent accumulations of plant material, while that in the subsoil consists mostly of that part of the organic matter which has been most resistant to decay. As plants decay, the nitrogen in the portion least resistant to decomposition is first converted into soluble or usable forms. The parts of the plant more resistant to decay tend to accumulate in the soil, and these contain the bulk of the soil nitrogen. Thus, that which is more available is found near the surface, and that less available in the subsoil.

The only practical means we have of restoring nitrogen removed is by means of legume crops. A small amount is fixed by electrical discharges and by bacteria which live in the soil independent of legumes, but the amounts so fixed are so small that we can not rely on such sources for profitable agriculture.

THE PHOSPHORUS CONTENT.

The soils of the county show a much lower average phosphorus content than the soils of the counties in the northeastern part of the state. The average phosphorus content of the surface soil in Brown and Riley counties is .059 per cent. This is nearly twice that of Reno county, where the average per cent for the surface and subsurface soil is .034, and for the subsoil .031. This, calculated to pounds per acre, gives 680 pounds for the surface seven inches, 1360 pounds for the subsurface thirteen inches, and 2160 pounds for the subsoil twenty inches. The clays and loams average a little higher than the sands and sandy soils, but this comparative difference is not as large as was noticed in the case of nitrogen. A study of the sands and sandy soils indicates that a large part of the phosphorus present in those soils is found in the organic matter near the surface. The following soils were sampled in native meadows or pastures:

	Sample No.	Per cent phosphorus.		
		Soil.	Sub surface.	Sub soil.
Smithwick fine sand	1149	0.024	....	0.022
Smithwick fine sand	1066	.030	0.031	.031
Pratt fine sandy loam	1173	.038	....	.028
Arkansas fine sandy loam	1064	.046	.034	.028
Lincoln fine sandy loam	1174	.037	.031	.024

The phosphorus has been brought from the lower strata by deep-rooted plants, and when these plants were either burned by prairie fires or left to decay the phosphorus accumulated near the surface.

The phosphorus content of all of the types, with few exceptions, is remarkably uniform. The Albion loamy coarse sand and the Dunesand are samples of soil of very low phosphorus content. The nitrogen content of these samples is also very low.

Crop Demands on Phosphorus

While the nitrogen is found in the organic matter, the phosphorus is mostly in the inorganic or mineral portion of the soil. This assumption in regard to phosphorus is based on the fact that the percentage decreased but little in the subsoil as compared with the surface soil. In the mineral form the phosphorus is insoluble, and as such is of no use to plants. But the same agencies which make nitrogen soluble will also make phosphorus soluble, and the decrease of organic matter, and consequently available nitrogen, will also be followed by a decrease of available phosphorus.

The time will come, no doubt, when artificial application of phosphorus will be profitable, but the resources of the farm should be constantly conserved and utilized before resorting to the application of commercial plant food.

THE POTASSIUM CONTENT.

The percentage of potassium in all of the Reno county soils is very high, and unlike the nitrogen and phosphorus, the potassium occurs in as large amounts in the sands and sandy soils as in the loams. The per cent of potassium in most of these soils is greater than in the ordinary mixed commercial fertilizer. Unlike nitrogen and phosphorus, potassium is found to the largest extent in the coarser part of the plant—the leaves and the stalk—and to a comparatively small extent in the grain. Forty bushels of wheat contains 11 pounds of potassium in the grain and 36 pounds in the straw. The same relative proportion is true for all the cereal crops. A soil which analyzes two per cent potassium—and most soils in Reno county contain more than this—contains 40,000 pounds in the surface seven inches. This is sufficient for 850 forty-bushel crops of wheat, grain and straw, and 3530 Crops, grain only. Where the straw is returned to the soil—and this is necessary in order to maintain the humus content—the supply of potassium will last indefinitely, and it is only necessary to make it available by the application of an abundance of organic matter.

A four-ton crop of alfalfa removes 207 pounds of potassium. Potassium, like phosphorus, is part of the mineral matter in the soil. This is of use to plants only when it becomes soluble. The agencies which make it soluble are inseparably connected with decaying vegetable matter. Selling alfalfa not only removes larger amounts of potassium than do grains, but removes those means by which the large stock in the soil is made soluble or usable for grain crops.

THE CALCIUM CONTENT.*

(See explanation of terms in the Appendix.)

As a class the soils of Reno county are high in calcium, and the content of calcium increases in the subsoil. The percentage of this element varies more than that of any other. Soils formed under humid conditions contain, as a rule, less calcium than soils formed under drier conditions, such as prevail in Reno county. Of twenty-six soils in Kansas whose origin is undoubtedly from limestone, the calcium content was found to be .75 per cent. Limestone, as an average, contains a little over 30 per cent of calcium. This means that this element is rapidly leached from the land; so rapidly, indeed, that limestone soils in regions of heavy rainfall early call for the application of calcium in the form of limestone in order to correct

* Calcium is the name of the element found in quicklime, slaked lime, and carbonate or pure limestone. Lime is a term used to represent any of these forms. The element calcium is never found as an element in the soil nor applied to the soil. It is found only in the form of its compounds, the most common being carbonate of lime or pure limestone.

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acidity. But where the rainfall is less the soils are well stocked with calcium. The soils of the east, which have been formed largely from limestone, are poorer in the element calcium than soils of the west, which have been formed from granites and other rocks originally much poorer in calcium. The large calcium content present in the soils of Reno county is due to the very small amount of leaching which has taken place.

THE CARBON CONTENT.

In the table in the Appendix the carbon is given as organic and inorganic. The first represents that present in the plant residues, the second that present in such substances as limestone. The presence of inorganic carbon indicates undecomposed carbonates, such as limestone. Most of these soils contain some carbon in the form of carbonates. Some contain only a trace, others very large amounts, and these larger amounts are found in the subsoil. As with calcium, these inorganic carbonates occur very irregularly, but it means that at present none of these soils are sour or in need of lime.

The soils of Reno county average lower in carbon than the soils farther east under more humid conditions. The sands and sandy soils have less organic matter stored in them by the growth of prairie grass, and the more open texture tends toward the rapid decay of organic matter. Decay is what makes organic matter useful. Undecayed matter may under some circumstances even do a positive harm. But this means that the stock of organic matter in the more open soils will be depleted sooner than the organic matter in the more compact soils, unless it is replenished. The loam soils contain 28,600 pounds of organic matter in the surface soil, and the fine sandy loams 16,000 pounds. To produce the 28,600 pounds of organic matter would take about 45 tons of wheat straw; to produce the 16,000 pounds would take about 25 tons. Rotation of crops in systems where little organic matter is returned, as well as intensive cultivation, tends to decrease the stock stored in the soil. With this decrease comes the loss of all the desirable soil properties associated with an abundance of organic matter. Probably the most serious problem connected with the soil of Reno county is that of keeping up the supply of organic matter.

SOIL PROBLEMS OF RENO COUNTY.

The many different soils found in the county naturally give rise to several soil problems. Some of the more important of these problems are: the maintenance of the supply of organic matter; the prevention of erosion on such soils as the Kirkland series; the treatment of alkali spots; and the utilization of the sandy land.

SUPPLY OF ORGANIC MATTER.

The problem of maintaining the supply of organic matter is a very serious one. Any cultivated soil is constantly losing its organic matter through decay. Unless it is supplied in some way the amount of this material becomes so low that decreased crop yields result. Organic matter enables the soil to hold more water, keeps it in good tilth, and through decay makes available the unavailable plant food of the soil. The loss of organic matter may cause decreased crop yields, not necessarily because the plant-food elements have been exhausted, but because there is no fresh organic matter present to make the supply of plant food available.

Organic matter is supplied by any kind of plant material. Cornstalks and straw are useful for this purpose. When they can not be used as feed or made into manure they should be worked into the soil. Such material should never be burned, for when burned the organic matter is destroyed. Organic matter may also be supplied by means of barnyard manure. On many farms it is impossible to maintain the supply by returning all fodder, straw and manure to the field. On such farms it is necessary to grow crops for the purpose of plowing under as green manure. Cowpeas and peanuts are well adapted to Reno county as green manuring crops. Since these crops are leguminous, they will add nitrogen to the soil as well as organic matter. However, all other sources of organic matter should be utilized before resorting to the use of green manuring crops, for in growing green manuring crops large amounts of water are used.

USE OF STRAW.

Wheat straw is undoubtedly one of the most valuable by-products of the farms of Reno county. At the present time a large quantity of the straw is burned or otherwise destroyed.

This results in a loss that the farmers of the county can not afford. The average annual production of straw in Reno county for the last five years has been 111,520 tons. This straw, if properly used on the land, would supply not only organic matter which would greatly increase the water-holding capacity of the soil, but would add as well over $341,000 worth of plant food annually. When burned, not only is the organic matter destroyed, but most of the plant food is lost as well.

The most economical way of handling the straw is to utilize as much of it as possible for feed and bedding, and then apply the manure to the soil. When it is not possible to follow this method the straw should be applied as a surface dressing on wheat during the winter at the rate of one to one and a half tons per acre. Heavier applications should be avoided. When top dressings of this kind are made the straw acts as a surface mulch and aids in the conservation of moisture. Later it becomes incorporated in the soil mass and supplies organic matter and plant food.

BARNYARD MANURE.

Barnyard manure is one of the best forms in which to supply organic matter. Fresh manure furnishes the largest amount of organic matter, and whenever possible should be applied in that condition. If manure is stored it decays rapidly, and organic matter as well as plant food is lost. One of the greatest wastes of plant food on the average farm results from the leaching and fermentation of manure. Half of the value of manure is lost when it is exposed to the weather for six months. The feed lot should always be cleaned out in the spring.

Manure can be applied with best results to crops like alfalfa, corn and kafir. It should be applied in small quantities and evenly spread over a large area. Manure can also be used with profit as a top dressing upon wheat, if it is distributed evenly. When used on wheat it should be applied in the fall or early winter. It will then serve as a protection to the wheat during a severe freeze and as a mulch to prevent evaporation during the following spring and summer.

EROSION.

On some of the steeper slopes of the county erosion has had a marked effect in depleting the soil of its fertility by removing the surface portion of the soil. This process has taken place to a noticeable degree in the Kirkland series. When a field is eroded and the surface soil removed the most valuable part of the soil is gone. The surface soil contains more humus and plant food than does the subsoil, and the plant food found in the subsoil is not as available as that in the surface soil.

A soil which will hold only a small amount of water is more subject to erosion than one which has greater water-holding power. Since organic matter increases the water-holding power of a soil, an abundance of organic matter in the soil will aid in preventing erosion. This is true not only because it will cause the soil to hold more water and prevent excessive surface flow, but also because the organic matter binds together the soil particles. Erosion may also be lessened by throwing fodder or straw into a wash as soon as it commences to form.

UTILIZATION OF SANDY LAND.

Some of the more sandy soils of Reno county are not well adapted to general farm crops and should be used more for special crops than for corn, wheat or kafir. Such soils are usually low in organic matter and quite subject to drouth, but open and easy to cultivate. They are also warmer, and therefore better adapted to early crops than the heavier soils. These soils respond readily to applications of barnyard mapure, and can be greatly improved by plowing under green manuring crops.

Because of the natural adaptability of the sandy soils, they should be used for truck crops, potatoes and small fruits where market conditions are favorable.

TREES FOR THE SAND HILLS OF RENO COUNTY.

The sand hills in this county are fairly well adapted for the growing of such trees as the Scotch and Austrian pines, red cedar, Chinese arbor vita and Russian wild olive. These trees are especially valuable for windbreaks and protection to stock on the range, and will in time be of commercial value. The red cedar and Chinese arbor vitæ are particularly desirable for poles and posts. The Scotch and Austrian pines when from forty to sixty years of age will yield considerable boxboard material. The Austrian pine will undoubtedly prove to be of much greater value than the Scotch pine in this respect. The commercial value of the Russian wild olive is not fully known, but the wood is believed to be very durable and desirable for post purposes.

In the valleys where the soil contains considerable humus, the hardy catalpa, in several instances, is making very satisfactory and profitable growth. However, the catalpa is not a tree well adapted for sandy soils and should be planted only in soils containing considerable humus.

One difficulty in establishing a plantation of any of these species is that of preventing the sand from blowing when the land is under cultivation. When planting pines, cedar or arbor vitæ it is not necessary that the ground be in a perfect state of cultivation, except in the valleys where the sod is heavy and dense. In the hills proper, where the sand is light, all the preparation that is necessary before planting is to plow a single furrow in which to set the trees. The furrows should be not over seven feet apart and the trees should be planted about three feet apart in them. This will give a stand of about 2400 trees per acre.

Close planting is desirable in order to develop a desirable form of tree. If allowed too much room these trees will develop heavy side branches in place of a strong trunk. After planting they require no cultivation, but must be amply protected against fires by a system of fire guards that will keep out approaching fires.

On the heavier soils where the grass sod is dense the ground must be in a good state of cultivation before the trees are planted. On such sites they must be given sufficient cultivation to keep down all grass and weeds until they shade the ground sufficiently to accomplish this purpose.

COMMERCIAL FERTILIZERS.

Commercial fertilizers are not used in Reno county, but more interest is being shown in their use each year, and the general nature of their effect on the soil should be understood. Commercial fertilizers supply one or more of the plant-food elements — nitrogen, phosphorus or potash. Most of the fertilizers found on the market are known as complete fertilizers, and contain all three of these elements. A fertilizer may be purchased which supplies but a single element.

Nitrogena.

A forty-bushel crop of wheat removes from the soil forty-six pounds of nitrogen, and a fifty-bushel crop of corn removes fifty pounds of nitrogen. This figures only the nitrogen contained in the grain, assuming that all the stalks and straw are returned to the soil. If the nitrogen in this forty-bushel crop of wheat were purchased as a commercial fertilizer it would cost $9.20. It would, therefore, cost about one-fourth the value of the wheat crop to supply by means of commercial fertilizers the nitrogen removed in the grain. It would be impracticable at present market prices to attempt to supply the nitrogen removed by wheat in this way. It would not only be impracticable, but it would be foolish when in the air above the soil there are millions of pounds of nitrogen which may be obtained by means of leguminous crops. In order that the wheat crop may receive the benefit of the nitrogen thus secured, leguminous crops, such as cowpeas, alfalfa and peanuts, should be grown in rotation with wheat, or manure obtained from feeding leguminous crops, cottonseed cake or oil meal should be applied to the ground upon which wheat is grown. With such a cheap and practical means of securing nitrogen from the air, it is only the unthinking farmer that would purchase nitrogen in any large quantity in the form of commercial fertilizers.

Phosphorus.

A forty-bushel crop of wheat, including the straw, removes about ten pounds of phosphorus. This simply means that when such a crop is removed so much plant food is removed, and the stock present in the soil is diminished by just so much. The difference between nitrogen and phosphorus is this: the ultimate supply of nitrogen is inexhaustible; the stock in the soil can be replenished from the large stock in the air, while phosphorus can not be so replenished. When that which is present in the soil is used up it is gone forever from the land.

Phosphorus occurs in the soils of Reno county in limited amounts, as was shown by the chemical analyses of the soils. Where good methods of cultivation are practiced and crop rotations are followed, phosphorus will be the first element of plant food to supply. It may be obtained in such commercial fertilizers as bone meal, acid phosphate or raw rock phosphate. Phosphorus can be obtained the cheapest in the form of raw rock phosphate, but when used in this form must be applied with barnyard manure or plowed under with a green manure crop. It has not proven profitable in Reno county in the past to use fertilizers supplying phosphorus, and until the time comes when the supply of available phosphorus is less abundant than at present, commercial fertilizers supplying this plant food should not be used. Commercial fertilizers should never be expected to replace barnyard manure or green manuring crops, but when employed should be used only where necessary to supplement these materials.

Potassium.

A chemical analysis of the soils of Reno county shows that the potassium content of the surface soil varies from 38,200 pounds to 46,600 pounds per acre. With this large supply of potassium in the soil and the small amount actually removed by grain crops, it is doubtful if it will ever become necessary to supply potassium by means of commercial fertilizers. The problem in potassium fertilizers is not to suply large quantities of this plant lood, but to liberate and make available the supply that is now in the soil in an available condition. This may be clone by practicing good methods of cultivation and keeping the soil well supplied with organic matter.

APPENDIX.

THREE METHODS OF CHEMICAL ANALYSIS OF SOILS.

The chemical analysis of a soil gives an inventory of the plant food present under the collditions of analysis. The methods employed in the chemical analysis of soils may be divided into three classes: (1) solution by water or weak acids; (2) solution by strong acids; (3) solution by strong acids after fusion. The first method gives the amount of plant food of immediate use to the plant at the time the analysis is made. This analysis furnishes an index to the immediate productive uses of the soil. It is very valuable in investigating systems of cropping and methods of handling the soil, but it has no value in a soil survey when it is desired to know the duration of the crop-producing power of the soil. Soil water always contains carbon dioxide where organic matter is present; in a state of decay other acids are also present. Consequently the soil water has the properties of a weak acid, and the strength is influenced by the amount of decaying organic matter present, and also by the physical condition of the soil, which to a large extent controls the rate of decay of organic matter.

SOLUTION BY STRONG ACIDS.

The method of solution by strong acids has been followed by soil analysts more than any other method. It was thought that, hydrochloric acid of the strength which remains constant during boiling would dissolve all the plant food which was possible for a plant ever to obtain. It was found that an acid of such strength would dissolve more plant food than a stronger or weaker acid. For this reason the results were taken as a measure of the duration of crop production. In this method nearly all the calcium is obtained, about 85 per cent of the phosphorus, and about 20 to 25 per cent of the potassium. Most tables on soil analysis in reports or books are on this basis. The weakness of this method is that the reults are in a measure relative. They represent the amount of plant food soluble at the time the analysis was made. The amount is subject to slow change. The acid-insoluble silicates, which contain the greater amount of the potassium and a small amount of the phosphorus, are continually acted on by the weathering agencies. The decay of organic matter, the freezing and thawing of every winter, the growth of crops and the cultivation of the soil slowly change these insoluble compounds into such as are soluble, first in strong acids and finally in weak acids.

SOLUTION BY STRONG ACIDS AFTER FUSION.

The solution by strong acids after fusion gives the total amount of elements present. Only those elements are determined which are likely to be present in such small amounts as to be inadequate for profitable crop production or those which notably influence crop production. At any one time only a small amount of this total is present in such form as to be soluble in weak acids and consequently of immediate use to the crop. But the greater the total amount present, the larger the amount that will be made soluble, provided the agencies which produce soluble plant food are equally active. Thus of two soils having, similar physical properties and the same content of decaying organic matter, the one which has the larger amount of total plant food will be the more fertile. There is no exception to this general rule.

NUMBER OF SOIL SAMPLES TAKEN.

Soil types which are predominant in the county were usually sampled in several places. Predominant types present several phases of variations, and where possible these were sampled. It is impossible to sample all the different shades of the type. Only those which are most pronounced are included. The types which occupy a relatively small area are usually sampled in only one place. Such types may show as much variation as those which are more extensive, but the number of samples must be limited in order that the means available may serve as large a section as is consistent with good work.

LOCATION OF SOIL SAMPLES TAKEN.

The place where a sample is taken is located by a method of United States land survey, ten acres being the smallest limit. In selecting the place to sample, a careful study is made of the type in regard to its formation and relation to other types. Unless the sample represents the type, the analysis is of comparatively little value; but if carefully taken a few samples represent large areas, and the results are applicable to all farms where the type occurs.

METHOD OF TAKING AND NUMBERING THE SOIL SAMPLES.

A soil sample for chemical analysis usually consists of three portions : soil, subsurface, and subsoil. The first is taken to a depth of 7 inches, or more exactly, 63 inches; the second from 7 to 20 inches, and the third from 20 to 40 inches. The first represents the soil as deep as plowing is usually practiced; the second depth represents the subsurface feeding-ground of most plants, and the third depth the lower feeding ground. Ordinarily soil to the depth of 63 inches weighs about 2,000,000 pounds per acre, the subsurface about 4,000,000 pounds, and the subsoil about 6,000,000 pounds. This makes it easy to compute the pounds per acre of any constituent when the percentage composition is known. The calculation only involves multiplying the percentage of the constituent by two, four, or six, with due regard to the decimal point. Thus, a percentage of one-tenth of any one constituent means 2000 pounds per acre for the surface soil, 4000 pounds for the subsurface, and 6000 pounds for the subsoil. With a little practice it is possible to read the pounds per acre from the table of the percentage of composition.

For taking the top soil a tube made of galvanized iron has been found very good. By means of this it is possible to obtain a uniform core from the surface down to seven inches, especially where the soil is loose on account of recent cultivation. For taking the subsurface and the subsoil a 1½-inch auger is a good tool. At least five borings are made for each sample, and the soil from each depth mixed into one portion. The soil sample is designated by a whole number, and the different portions by the decimals .1, .2, and .3 placed after the number. Thus, soil samples numbered 1134.1, 1134.2, and 1134.3 mean the soil, subsurface and subsoil from sample 1134. Occasionally, by reason of peculiar local conditions, only one or two portions are taken. In some places the subsurface and subsoil are so full of small stones that boring is impossible.

The following table gives the analyses of all the soil types sampled in Reno county. It shows the location at which the sample was taken; the type of soil and stratum sampled; the sample number; and the percentage of plant-food elements—nitrogen, phosphorus, potassium, calcium, and organic and inorganic carbon.

ANALYSIS OF SOILS FROM RENO COUNTY.

Location by Land Survey.	Type as given in soil survey.	Stratum sampled, inches.	Sample No.	Percentages of plant-food elements. Nitrogen.	Phosphorus.	Potassium.	Calcium.	Organic carbon.	Inorganic carbon.
S. W. 10 of S. W. 40 of S. W. ¼, Sec. 7, Twp. 25 S., R. 5 W.	Kirkland clay, Alfalfa sod	Soil 0-7	1181.1	0.205	0.041	2.02	2.43	2.03	0.635
		Subsurface 7-16	1181.2	0.101	0.040	1.65	4.83	1.46	0.368
S. E. 10 of S. E. 40 of N. E. ¼, Sec. 4, Twp. 26 S., R. 5 W.	Kirkland Clay, Cultivated	Soil 0-7	1186.1	0.127	0.038	2.33	0.58	1.31	0.103
		Subsurface 7-24	1186.2	0.095	0.048	2.54	0.92	0.78	0.911
S. W. 10 of S. E. 40 of S. E. ¼, Sec. 7, Twp. 22 S., R. 10 W.	Arkansas clay, Cultivated	Soil 0-10	1167.1	0.124	0.042	2.13	0.56	1.23	0.004
		Subsurface 10-20	1167.2	0.035	0.040	2.36	0.42	0.24	0.003
	Average	Soil		0.152	0.040	2.16	1.19	1.52	0.247
		Subsurface		0.077	0.043	2.18	2.06	1.42	0.427
N. E. 40 of N. E. ¼, Sec. 9, Twp. 24 S., R. 8 W.	Clark clay loam, Cultivated	Soil 0-7	1172.1	0.173	0.035	2.06	0.57	1.80	0.003
		Subsurface 7-20	1172.2	0.093	0.032	1.97	0.49	0.85	0.581
		Subsoil 20-40	1172.3	0.039	0.035	1.95	3.69	0.39	0.892
N. W. 10 of S. W. 40 of N. W. ¼, Sec. 25, Twp. 22 S., R. 6 W.	Arkansas clay loam, Native meadow	Silo 0-7	1159.1	0.181	0.038	2.04	0.86	2.08	0.049
		Subsurface 7-20	1159.2	0.088	0.034	1.91	0.94	1.02	0.111
		Subsoil 20-40	1159.3	0.056	0.039	1.93	3.59	0.59	0.962
S. E. 10 of N. E. ¼, Sec. 28, Twp. 23 S., R. 4 W.	Arkansas clay loam, Cultivated	Soil 0-7	1157.1	0.115	0.038	1.73	0.72	1.20	0.003
		Subsurface 7-20	1157.2	0.068	0.039	1.86	1.23	0.69	0.101
		Subsoil 20-40	1157.3	0.047	0.045	1.90	1.93	0.38	0.320
	Average	Soil		0.156	0.037	1.94	0.72	1.69	0.018
		Surface		0.083	0.035	1.91	0.89	0.85	0.264
		Subsoil		0.047	0.040	1.93	3.07	0.45	0.728
N. E. 10 of N. E. 40 of N. W. ¼, Sec. 16, Twp. 22 S., R. 4 W.	Pratt silty clay loam, Cultivated	Soil 0-7	1151.1	0.161	0.035	1.90	0.62	1.82	0.003
		Subsurface 7-20	1151.2	0.100	0.034	1.90	0.62	1.01	0.002
		Subsoil 20-40	1151.3	0.061	0.040	1.93	1.00	0.46	0.061
S. W. 10 of S. W. 40 of S. W. ¼, Sec. 2, Twp. 22 S., R. 4 W.	Pratt silty clay loam, black phase, Cultivated	Soil 0-7	1152.1	0.160	0.034	1.94	0.559	1.89	0.004
		Subsurface 7-20	1152.2	0.100	0.036	1.82	0.62	1.08	0.002
		Subsoil 20-30	1152.3	0.058	0.038	1.83	0.79	0.57	0.051
N. E. 10 of N. E. 40 of N. E. ¼, Sec. 30, Twp. 22 S., R. 10 W.	Pratt silty clay loam, alkali phase, Native pasture	Soil 0-4	1166.1	0.084	0.047	2.02	0.82	0.81	0.026
	Average	Soil		0.135	0.039	1.95	0.67	1.51	0.011
		Subsurface		0.100	0.035	1.86	0.62	1.04	0.002
		Subsoil		0.060	0.039	1.88	0.89	0.51	0.056

N. W. 10 of N. W. 40 of N. W. ¼,	Pratt sandy clay loam,	Soil............0–7	1180.1	0.148	0.040	1.91	0.50	1.43	0.007
Sec. 4, Twp. 26 S., R. 6 W...........	Cultivated...................................	Subsurface.....7–20	1180.2	0.091	0.034	1.88	0.74	0.84	0.030
		Subsoil.......20–40	1180.3	0.041	0.023	1.94	0.89	0.16	0.118
N. E. 10 of N. E. 40 of S. E. ¼,	Pratt loam,	Soil............0–7	1071.1	0.170	0.043	2.07	0.52	1.87	Trace.
Sec. 23, Twp. 23 S., R 7. W.........	Native pasture..............................	Subsurface.....7–20	1071.2	0.093	0.037	2.18	0.50	0.95	Trace.
		Subsoil.......20–40	1071.3	0.057	0.049	2.24	0.63	0.36	None.
S. W. 10 of S. W. 40 of N. W. ¼,	Pratt loam,	Soil............0–7	1070.1	0.116	0.044	2.10	0.42	1.05	Trace.
Sec. 13 Twp. 24 S., R. 5 W..........	Cultivated...................................	Subsurface.....7–20	1070.2	0.106	0.051	2.04	0.47	0.75	Trace.
		Subsoil.......20–40	1070.3	0.055	0.050	1.99	0.44	0.32	Trace.
S. E. 10 of S. E. 40 of N. E. ¼.	Pratt loam,	Soil............0–7	1164.1	0.094	0.023	2.02	0.39	1.06	0.004
Sec. 18, Twp. 24 S., R. 5 W.........	Cultivated...................................	Subsurface.....7–20	1164.2	0.075	0.030	1.88	0.41	0.86	0.002
		Subsoil.......20–40	1164.3	0.050	0.026	2.15	0.47	0.55	0.002
N. W. 10 of N. W. 40 of N. W. ¼,	Albion loam,	Soil............0–7	1184.1	0.150	0.028	2.11	0.11	1.67	0.024
Sec. 17, Twp. 26 S., R. 6 W.........	Cultivated...................................	Surface........7–20	1184.2	0.115	0.024	2.02	0.77	1.17	0.041
		Subsoil.......20–40	1184.3	0.075	0.017	2.34	0.18	0.64	0.004
S. E. 10 of N. E. 40 of N. E. ¼,	Clark loam,	Soil............0–7	1170.1	0.106	0.037	2.10	0.65	0.98	0.018
Sec. 30, Twp. 25 S., R. 9 W.........	Cultivated...................................	Subsurface.....7–20	1170.2	0.097	0.041	2.05	1.86	1.01	0.819
		Subsoil.......20–40	1170.3	0.048	0.041	2.01	1.45	1.36	0.347
S. E. 10 of S. E. 40 of N. E. ¼,	Englewood loam,	Soil............0–7	1182.1	0.178	0.039	1.55	2.13	1.71	0.524
Sec. 32, Twp. 25 S., R. 5 W.........	Cultivated...................................	Subsurface.....7–20	1182.2	0.090	0.033	1.43	4.10	1.14	1.175
		Subsoil.......20–40	1182.3	0.042	0.040	1.44	5.90	0.42	2.100
S. E. 10 of N. E. 40 of S. W. ¼,	Arkansas loam,	Soil............0–7	1063.1	0.163	0.034	2.40	0.58	1.77	0.045
Sec. 21, Twp. 22 S., R. 6 W.........	Cultivated...................................	Subsurface.....7–20	1063.2	0.101	0.029	2.61	0.84	1.14	0.150
		Subsoil.......20–40	1063.3	0.037	0.025	2.54	0.56	0.24	....
S. W. 10 of S. W. 40 of N. W. ¼,	Arkansas loam,	Soil............0–7	1154.1	0.115	0.050	2.37	0.46	1 32	0.002
Sec. 30, Twp. 23 S., R. 4 W.........	Cultivated...................................	Subsurface.....7–20	1154.2	0.085	0.051	2.17	1.02	0.86	0.094
		Subsoil.......20–40	1154.3	0.048	0.055	2.11	2.44	0.43	0.640
		Soil...............	....	0.137	0.037	2.09	0.66	1.43	....
	Average....................................	Subsurface.........	....	0.095	0.037	2.05	1.25	0.99	....
		Subsoil............	....	0.052	0.038	2.10	1.51	0.54	....
S. W. 10 of N. W. 40 of N. W. ¼	Albion sandy loam,	Soil............0–7	1185.1	0.095	0.025	2.19	0.49	1.11	0.003
Sec. 20, Twp. 26 S., R. 6 W.........	Cultivated...................................	Subsurface.....7–20	1185.2	0.073	0.017	2.23	0.29	0.82	0.002
		Subsoil.......20–40	1185.3	0.044	0.012	2.41	0.34	0.37	0.002
S. W. 10 of S. W. 40 of S. E. ¼,	Clark sandy loam, coarse phase....................	Soil............0–7	1177.1	0.144	0.037	1.50	1.85	1.47	0.472
Sec. 8, Twp. 26 S., R. 7 W...........	Cultivated...................................	Subsurface.....7–20	1177.2	0.062	0.026	1.43	3.55	0.54	1.019
		Subsoil.......20–40	1177.3	0.023	0.027	1.29	2.87	0.18	0.835

ANALYSIS OF SOILS FROM RENO COUNTY—Continued.

Location by Land Survey.	Type as given in soil survey.	Stratum sampled, inches.	Sample No.	Percentages of plant-food elements.					
				Nitrogen.	Phosphorus.	Potassium.	Calcium.	Organic carbon.	Inorganic carbon.
S. E. 10 of S. E. 40 of S. E. ¼, Sec. 32, Twp. 25 S., R. 5 W.	Englewood sandy loam, Cultivated	Soil......0–7	1183.1	0.070	0.040	2.01	1.88	0.75	0.675
		Subsurface.....7–20	1183.2	0.067	0.058	1.63	7.38	0.68	2.529
		Subsoil.......20–40	1183.3	0.048	0.058	1.47	11.97	0.27	3.660
S. W. 10 of N. W. 40 of N. W. ¼, Sec. 30, Twp. 25 S., R. 8 W.	Lincoln sandy loam, Alfalfa	Soil......0–12	1171.1	0.087	0.025	2.29	0.80	0.72	0.120
		Subsoil.......12–30	1171.2	0.043	0.026	2.38	0.57	0.33	0.061
	Average	Soil	....	0.097	0.032	2.00	1.26	1.01	0.318
		Subsurface	....	0.067	0.033	1.76	3.74	0.68	1.183
		Subsoil	....	0.040	0.031	1.89	3.94	0.29	1.140
S. E. 10 of S. E. 40 of N. E. ¼, Sec. 30, Twp. 23 S., R. 7. W.	Pratt very fine sandy loam, Cultivated	Soil......0–7	1175.1	0.080	0.031	2.28	0.55	0.96	0.023
		Subsurface.....7–20	1175.2	0.056	0.021	2.16	0.52	0.61	0.016
		Subsoil.......20–40	1175.3	0.032	0.020	2.23	0.41	0.32	0.016
N. W. 10 of N. W. 40 of N. W. ¼, Sec. 6, Twp. 26 S., R. 7 W.	Vernon very fine sandy loam, Cultivated	Soil......0–7	1176.1	0.115	0.033	1.79	0.47	1.17	0.047
		Subsurface.....7–20	1176.2	0.091	0.033	1.77	0.93	0.84	0.248
		Subsoil.......20–40	1176.3	0.064	0.034	1.78	1.09	0.53	0.259
N. E. 10 of S. E. 40 of N. E. ¼, Sec. 19, Twp. 23 S., R. 7 W.	Lincoln very fine sandy loam, Native meadow	Soil......0–7	1174.1	0.135	0.037	2.16	0.60	1.49	0.004
		Subsurface.....7–20	1174.2	0.059	0.031	2.06	0.70	0.59	0.114
		Subsoil.......20–40	1174.3	0.029	0.024	2.04	1.28	0.24	0.263
	Average	Soil	....	0.110	0.034	2.08	0.54	1.21	0.025
		Subsurface	....	0.069	0.028	2.00	0.72	0.68	0.126
		Subsoil	....	0.042	0.026	2.02	0.93	0.36	0.179
S. E. 10 of S. E. 40 of S. E. ¼, Sec. 15, Twp. 24 S., R. 6 W.	Pratt fine sandy loam, Cultivated	Soil......0–7	1165.1	0.073	0.025	2.05	0.38	0.86	0.002
		Subsurface.....7–20	1165.2	0.069	0.026	2.08	0.42	0.57	0.005
		Subsoil.......20–40	1165.3	0.055	0.028	2.13	0.61	0.45	0.001
S. E. 10 of S. E. 40 of S. E. ¼, Sec. 25, Twp. 22 S., R. 6 W.	Pratt fine sandy loam, Cultivated	Soil......0–7	1162.1	0.109	0.033	1.98	0.50	1.27	0.003
		Subsurface.....7–20	1162.2	0.074	0.032	2.06	0.61	0.70	0.003
		Subsoil.......20–40	1163.3	0.049	0.031	2.04	0.74	0.48	0.001
S. E. 10 of S. E. 40 of S. E. ¼, Sec. 14, Twp. 24 S., R. 6 W.	Pratt fine sandy loam, Alfalfa	Soil......0–7	1069.1	0.081	0.036	2.28	0.28	0.66	None.
		Subsurface.....7–20	1069.2	0.075	0.035	2.26	0.30	0.50	Trace.
		Subsoil.......20–40	1069.3	0.051	0.031	2.27	0.29	0.26	None.

N. E. 10 of N. E. 40 of N. E ¼, Sec. 35, Twp. 23 S., R. 8 W	Pratt fine sandy loam, coarse phase, Native pasture	Soil 0-10	1173.1	0.082	0.038	1.79	4.55	0.87	1.304
		Subsurface 10-25	1173.2	0.026	0.028	1.77	4.81	0.10	1.423
N. W. 10 of S. W 40 of S. W. ¼, Sec. 21, Twp. 22 S., R. 6 W	Arkansas fine sandy loam, Native meadow	Soil 0-7	1064.1	0.076	0.046	2.64	0.51	0.77	0.052
		Subsurface 7-20	1064.2	0.046	0.034	2.66	0.59	0.40	Trace.
		Subsoil 20-40	1064.3	0.046	0.028	2.10	0.58	0.32	Trace.
S. E. 10 of N. W. 40 of N. E. ¼, Sec. 31, Twp. 22 S., R. 6 W	Arkansas fine sandy loam, Apple orchard	Soil 0-7	1065.1	0.076	0.043	2.36	0.58	0.64	Trace.
		Subsurface 7-20	1065.2	0.075	0.045	2.58	0.63	0.60	0.062
		Subsoil 20-40	1065.3	0.046	0.048	2.55	1.81	0.21	1.41
S. W. 10 of S. W. 40 of S. W. ¼, Sec. 11, Twp. 23 S., R. 5 W	Arkansas fine sandy loam, Apple orchard	Soil 0-5	1067.1	0.059	0.020	2.29	0.36	0.49	Trace.
		Subsurface 5-18	1067.2	0.068	0.021	2.42	0.59	0.54	0.465
		Subsoil 18-36	1067.3	0.054	0.023	2.50	0.62	0.39	0.402
N. W. 10 of S. W. 40 of N. W. ¼, Sec. 9, Twp. 24 S., R. 4 W	Arkansas fine sandy loam, Cultivated	Soil 0-7	1155.1	0.064	0.033	2.49	0.51	0.50	0.024
		Subsurface 7-20	1155.2	0.046	0.036	2.43	0.61	0.45	0.002
		Subsoil 20-40	1155.3	0.034	0.031	2.26	0.99	0.33	0.152
N. W. 10 of N. W. 40 of N. E. ¼, Sec. 27, Twp. 22 S., R. 4. W	Lincoln fine sandy loam, Cultivated	Soil 0-7	1153.1	0.100	0.038	2.07	0.39	1.11	0.002
		Subsurface 7-20	1153.2	0.094	0.042	2.07	0.40	0.91	0.007
		Subsoil 20-30	1153.3	0.069	0.044	2.14	0.67	0.62	0.001
	Average	Soil		0.080	0.035	2.22	0.89	0.80	
		Subsurface		0.064	0.033	2.26	0.99	0.53	
		Subsoil		0.051	0.033	2.22	0.79	0.38	
N. E. 10 of N. E. 40 of N. W. ¼, Sec. 15, Twp. 25 S., R. 10 W	Pratt loamy fine sand, Cultivated	Soil 1-12	1169.1	0.032	0.019	2.46	0.40	0.25	0.009
		Subsurface							
		Subsoil 12-40	1169.2	0.027	0.017	2.45	0.34	0.19	0.006
N. W. 10 of S. W. 40 of S. W. ¼, Sec. 10, Twp. 24 S., R. 10 W	Pratt loamy fine sand, Cultivated	Soil 0-12	1168.1	0.032	0.014	2.37	0.18	0.28	0.004
		Subsoil 12-36	1168.2	0.029	0.018	2.38	0.25	0.23	0.008
	Average	Soil		0.032	0.017	2.42	0.29	0.27	
		Subsoil		0.028	0.018	2.42	0.30	0.21	
S. W. 10 of S. W. 40 of S. E. ¼, Sec. 3, Twp. 26 S., R. 7 W	Albion loamy coarse sand, Cultivated	Soil 0-12	1178.1	0.054	0.016	2.33	0.21	0.57	0.002
		Subsurface							
		Subsoil 12-36	1178.2	0.034	0.018	2.43	0.25	0.33	0.004
N. E. 10 of S. E. 40 of S. E. ¼, Sec. 33, Twp. 22 S., R. 4 E	Smithwick fine sand, heavy subsoil phase, Cultivated	Soil 0-9	1150.1	0.077	0.031	2.01	0.52	0.93	0.007
		Subsurface 9-20	1150.2	0.073	0.034	1.95	0.72	0.78	0.005
		Subsoil 20-40	1150.3	0.036	0.028	1.89	0.92	0.38	0.062

ANALYSIS OF SOILS FROM RENO COUNTY—CONCLUDED.

Location by Land Survey.	Type as given in soil survey.	Stratum sampled, inches.	Sample No.	Percentages of plant-food elements.					
				Nitrogen.	Phosphorus.	Potassium.	Calcium.	Organic carbon.	Inorganic carbon.
N. W. 10 of N. W. 40 of N. W. ¼, Sec. 31, Twp. 22 S., R. 6 W.	Arkansas fine sand, Catalpa	Soil 0–30	1160.1	0.034	0.026	2.43	0.55	0.28	0.002
N. E. 10 of S. E. 40 of N. E. ¼, Sec. 11, Twp. 23 S., R. 5 W.	Smithwick fine sand, Native meadow	Soil 0–7	1066.1	0.056	0.030	2.44	0.27	4.48	Trace.
		Subsurface 7–20	1066.2	0.036	0.031	2.40	0.30	0.14	None.
		Subsoil 20–40	1066.3	0.029	0.031	2.45	0.26	0.14	Trace.
N. W. ¼, Sec. 33, Twp. 22 S., R. 4 W.	Smithwick fine sand, Native meadow	Soil 1–16	1149.1	0.101	0.024	1.93	1.21	1.13	0.220
		Subsoil 16–36	1149.2	0.063	0.022	1.96	2.02	0.69	0.463
	Average	Soil	....	0.067	0.028	2.20	0.64	1.71	....
		Subsurface	....	0.055	0.033	2.18	0.51	0.46	....
		Subsoil	....	0.043	0.027	2.10	1.09	0.40	....
N. E. ¼, Sec. 1, Twp. 23 S., R. 5 W.	Dunesand, Native pasture	Soil 1–10	1148.1	0.017	0.018	2.02	0.36	0.22	0.001
		Soil 1–20	1148.2	0.042	0.018	2.11	0.41	0.33	0.002
		Subsoil 20–40	1148.3	0.022	0.018	2.06	0.46	0.20	0.002
N. E. 10 of S. W. 40 of S. W. ¼, Sec. 32, Twp. 23 S., R. 5 W.	Meadow, Native pasture	Soil 0–7	1163.0	0.104	0.070	2.18	2.54	1.15	0.653
	Average for county	Soil	....	0.106	0.034	2.08	0.88	1.17	....
		Subsurface	....	0.076	0.034	1.99	1.47	0.80	....
		Subsoil	....	0.045	0.031	2.05	1.73	0.42	....

Reno

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