RECONNAISSANCE

MAY 1955
BULLETIN 449

SOIL SURVEY OF *Potter* COUNTY SOUTH DAKOTA

AGRONOMY DEPARTMENT — AGRICULTURAL EXPERIMENT STATION

SOUTH DAKOTA STATE COLLEGE • BROOKINGS
IN COOPERATION WITH THE SOIL CONSERVATION SERVICE USDA

COVER PAINTING

ROUGH COUNTRY by HARVEY DUNN. This painting by a native South Dakotan captures the rhythms of the great rolling swells and dips of the rough break country along the Missouri River in western Potter County.

SUMMARY

Potter County covers an area of 568,320 acres in north central South Dakota. The topography is gently sloping in the central part with a belt of hilly land along the east border and the steep, dissected bluffs of the Missouri River trench along the west border of the county. Elevations above sea level range from 1,900 to 2,000 feet on the upland to 1,600 feet on the Missouri River flood plain.

Materials from which the soils have developed include glacial deposits which occur in all parts of the county except on the Missouri River bluff where shale is exposed.

Soils of the county have been classified into 35 mapping units, each of which is described with regard to composition, distribution, and agricultural use. Principal problems of management are discussed and estimated yields of important crops are given for each soil, along with its potential irrigability.

A NOTE ABOUT THIS SURVEY

This is a reconnaissance soil survey which provides a broad picture of the soil pattern of Potter County. It was not designed to take into consideration all of the detailed soil variations that may occur on any farm. The crop yield predictions which appear in the bulletin are the best estimates available of the yielding power of the soils but should not be regarded as proven facts. The purpose of this soil survey is to extend as far as possible the present soils and crops research knowledge to the fields of Potter County.

RECONNAISSANCE

SOIL SURVEY OF *Potter County*

HOW SOIL MAPS ARE MADE

Soil maps are made by actually observing the soils in the field. The boundaries between the different kinds of soils are plotted on aerial photographs by soil scientists as they systematically observe the soil characteristics not only at the surface but to depths of 60 inches or more. Soils may be sandy or clayey, hilly or level, stony or nonstony, shallow or deep. The soil map shows where each kind of soil occurs.

HOW TO USE THIS SOIL SURVEY

(The soil map is in an envelope attached to the inside back cover)

For Farmers

You will find on careful study of this material something of the collateral you have in your soil bank. You can determine how best to make the assets of this soil bank serve you and your family. Here is how—

1—**Find Your Farm or Ranch.** This can be done from your legal description. Township, range, and section numbers appear on the map. Outline your farm or ranch.

2—**Look Up Your Soil.** You will find the soil numbers in red on your map. Different numbers show that soils differ on various parts of your land. Note the soils present in your fields. You can look up descriptions of these soils starting on page 17 of the bulletin.

3—**Plan Your Land Use.** Beginning on page 47 is information dealing with the management of your soils. Assume you have located your farm or ranch and you have some of the soil number 2. On page 54 you will find estimated yields of crops you can expect by using the management practices specified in the table.

For Other Users

This survey provides information on—

1—Location of the most productive areas

2—General expected production and adapted crops for any farm

3—General expected yield increases that would result from improved soil management practices

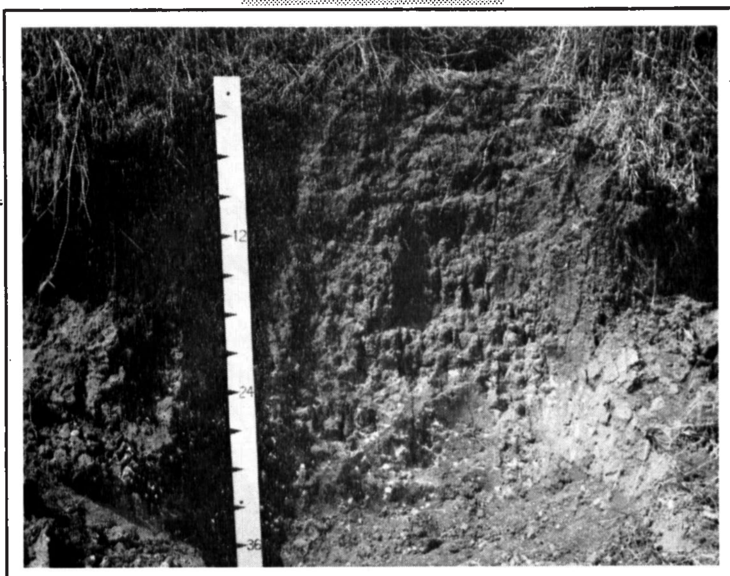
4—Location of lands which show promise for irrigation development

5—Soil profiles, their formation and classification

6—Climate, land forms, relief, and agriculture of Potter County

RECONNAISSANCE

SOIL SURVEY OF Potter County



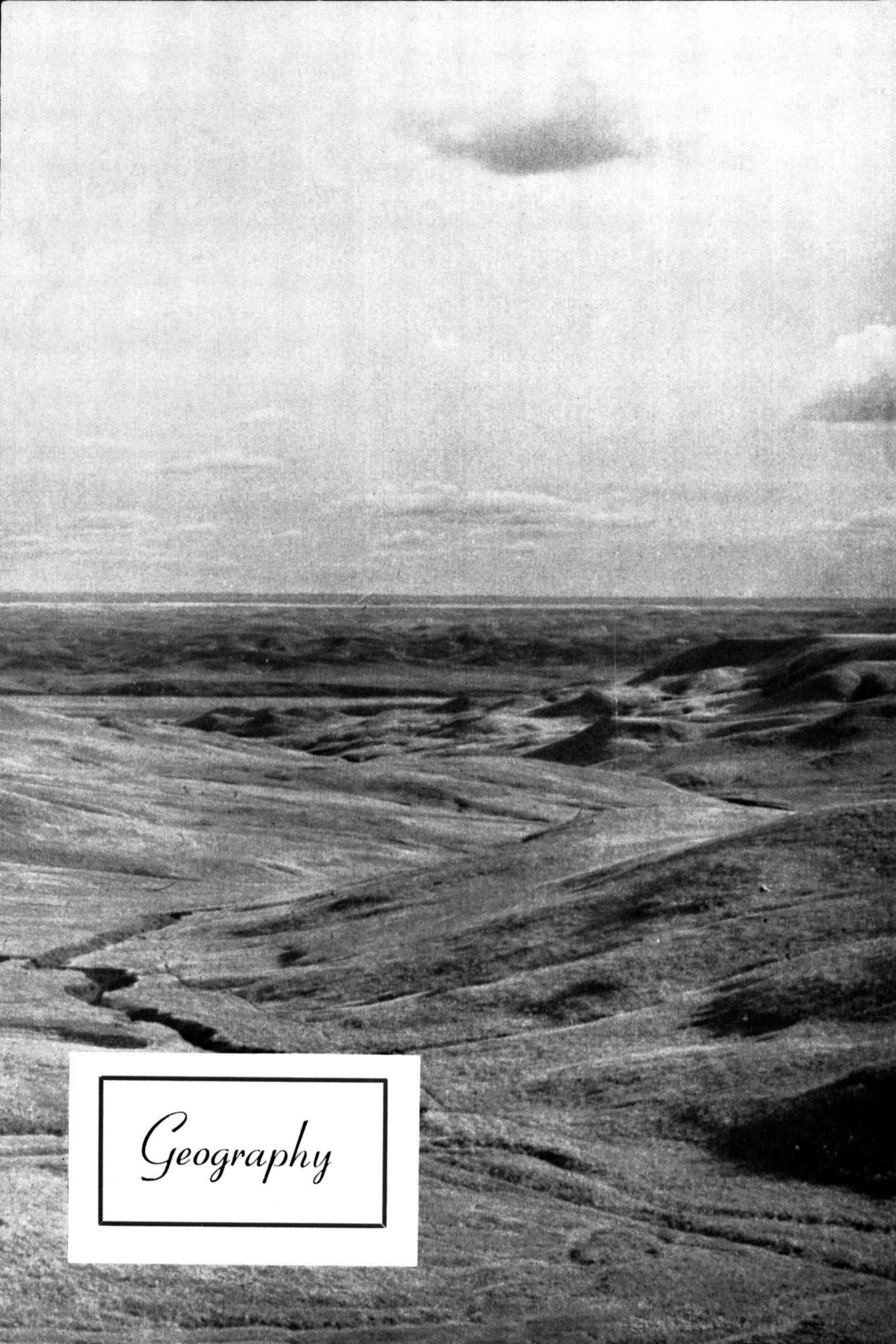
W. I. Watkins, G. J. Buntley, F. C. Westin, and F. E. Shubeck

AGRONOMY DEPARTMENT
AGRICULTURAL EXPERIMENT STATION
SOUTH DAKOTA STATE COLLEGE • BROOKINGS

CONTENTS

FIGURES

TABLES



Geography

NATURAL GEOGRAPHY

DESCRIBED BRIEFLY in this section are important features of the landscape. Physiography, relief, drainage, soil parent material, climate, and native vegetation all affect soil formation and use of soils for agriculture. Knowledge of these features will aid in understanding the subsequent discussion of soils.

Potter County lies in the north central part of South Dakota. The air mileage from Gettysburg, the county seat, to Pierre, the state capital, and to other towns and cities in South Dakota is shown in figure 1. The county is 42 miles by 24 miles with the long dimension east and west. It contains 568,320 acres.

Potter County lies in the northern part of the highland area just east of the Missouri River called the Missouri Coteau (figure 2). This coteau, which was named by early French fur traders, is a remnant of a former nearly flat bedrock surface which was extensively eroded before the area was glaciated. Although all of Potter County was glaciated several times, much of the dissected area in a belt close to the Missouri River lacks a cover of drift because of erosion since glacial times. These *breaks,* as they are referred to locally, consist of closely spaced, steep sided ravines cut in bedded shale.

General Soil Areas

For convenience of discussion, Potter County may be divided into seven general soil areas (figure 3).

Soil area A consists of the Missouri River flood plains and terraces. They are generally nearly level in slope except for short steep escarpments separating flood plain from terrace. Their general elevation is about 1,600 feet.

Soil area B comprises the sideslopes of the Missouri River trench and consists of steep, dissected bluffs 300-400 feet above the river.

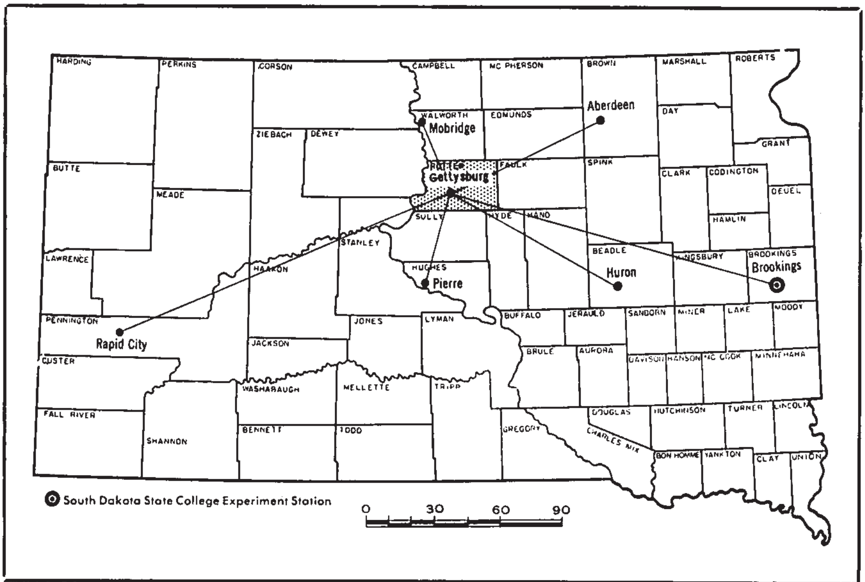


Figure 1. Location and extent of Potter County

Soil area C is an undulating to rolling area of clayey soils. This area occurs just east of the Missouri River trench in the northwestern part of the county.

Soil area D extends eastward from soil areas B and C and is a broad central upland ending at a conspicuous belt of hilly land in eastern Potter County.

This central upland is loess mantled for the most part and consists of swell - and - swale topography of rather low local relief with scattered depressions, some of which are shallow and a few of which contain marshes and intermittent lakes.

Occasionally a sharply marked hilly area interrupts the broad sweep of this upland as it does about 6 miles north-northwest of Gettysburg. This is an area of about 9 square miles which consists of a series of rather steep, round-topped hills with short slopes and a few scattered depressions.

Soil area E, located between the Central Upland and the eastern belt of hilly land, is a flat expanse of sand and gravel washed out from the glacier ice as it stood at the moraine. This outwash area is covered with loess or alluvium.

Soil area F, the hilly land in eastern Potter County, is the system of end moraines which comprise about a fifth of Potter County. This area rises sharply from the gently sloping plain to the west and consists of a series of steep, round-topped hills and knolls many of which are strewn with boulders, separated by swales and marshes.

Soil area G, east of the hilly area F, is an undulating plain of low

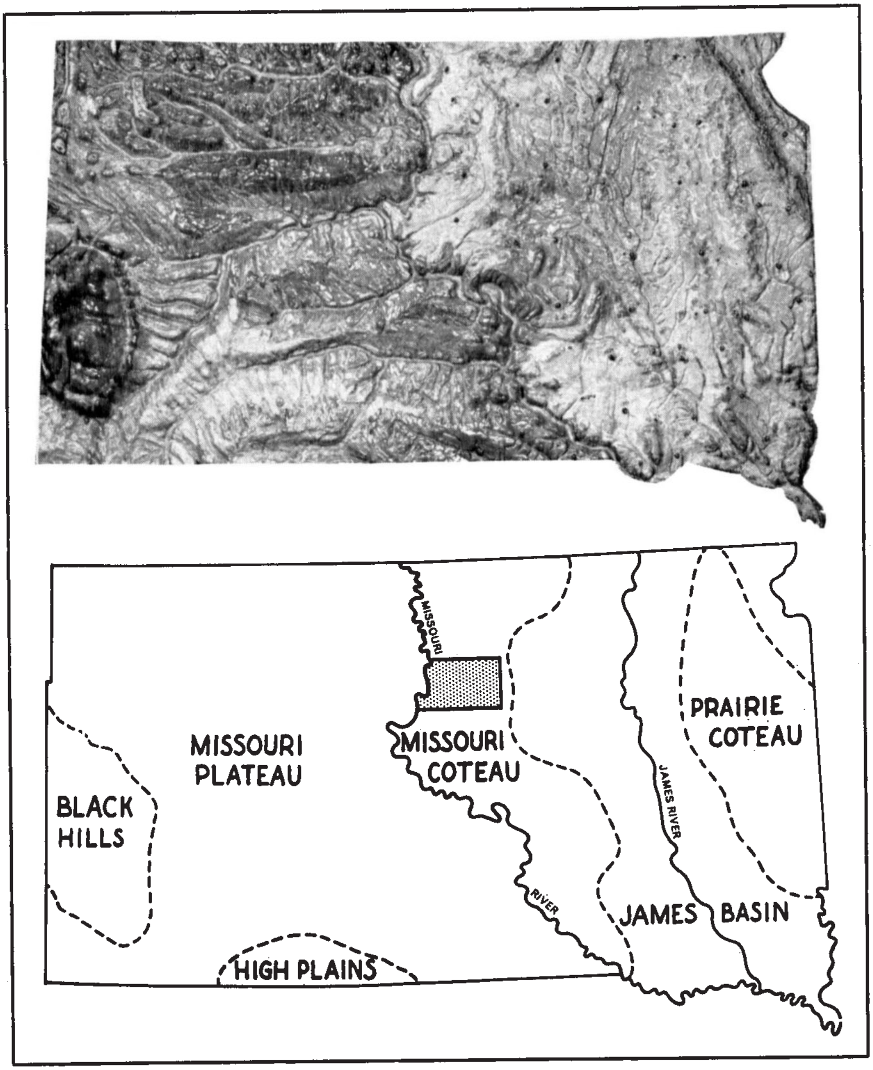
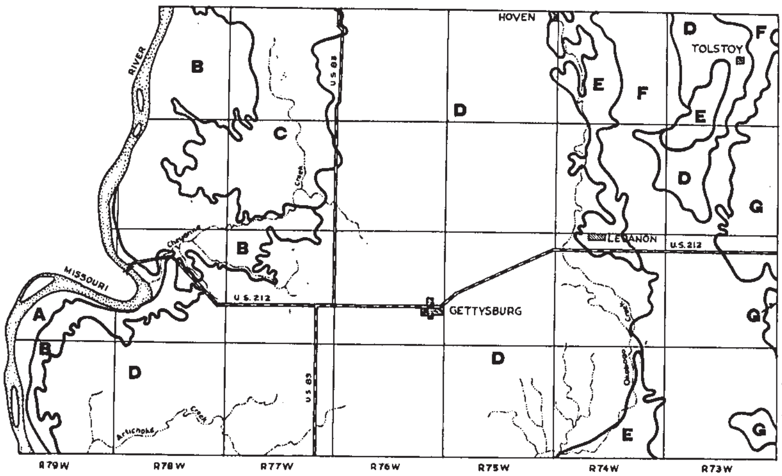


Figure 2. Physiography of South Dakota

relief. Soil area G differs from area D by having undulating rather than sloping topography and by having no loess mantle.

Stream drainage is generally rather poorly developed in Potter County. Much of the drainage is interior in the Central Plain, the outwash area, and the Eastern Moraine. Here the runoff drains into local depressions. Sometimes several local depressions are connected by poorly definied channels which may carry water during a wet season.

In addition to the Missouri River, the principal streams are Little



A Nearly level alluvial and terrace soils of variable texture

B Steep, dissected clayey soils (chiefly Pierre and Lismas)

C Undulating to rolling clayey soils (chiefly Promise and Hurley)

D Nearly level to sloping silty soils (chiefly Agar)

E Nearly level silty and loamy soils outwash sand and gravel (chiefly Akaska and Oahe)

F Rolling loamy soils (chiefly Zahl and Williams)

G Undulating loamy soils (chiefly Williams)

Figure 3. General soil areas of Potter County

Cheyenne, Artichoke, and Okobojo. These streams flow west or southwest to join the Missouri River. Many closely spaced short tributaries work headward several miles into the highlands east of the Missouri River trench in soil area B.

Soil Parent Materials

The nature of the soils which occur in an area is due to the combined influences of several factors, one of which is the kind of materials from which the soils have developed. Five important kinds of parent materials have left their marks on Potter County soils—loess, glacial till, shale, outwash, alluvium.

Loess consists of uniform silty sediments laid down by the wind usually following the melting of a glacier. In Potter County the loess occurs as a mantle overlying most of the Central Upland (soil area D, figure 3). The loess in this area varies from several to many feet thick over substrata of glacial till or Pierre shale. Loess also occurs mantling some of the outwash in soil area E, figure 3, and a recent loess, apparently derived locally from the Missouri River flood plain, overlies some of the terraces and sideslopes of the Missouri River trench (soil areas A and B, figure 3).

Glacial till, laid down by ice, consists of unsorted mixtures of clay, silt, sand, gravel, and boulders in variable proportions. Glacial till is the main soil parent material of soil area G and of the belt of end moraine in eastern Potter County (soil area F, figure 3). It also occurs as scattered patches in the Central Upland (soil areas C and D, figure 3). Except for the dark finer textured clay to clay loam till in soil area C, the till is mostly yellowish brown and is a loam or light clay loam in texture.

Shale is a sedimentary rock formed when clay-size particles were deposited and later consolidated on the floor of an ancient sea. The shales exposed in Potter County occur mainly in dissected bluffs and deep ravines in a belt close to the Missouri River (soil area B, figure 3). The shale is dark brownish-green and is weakly consolidated, so it has slumped in places to give a knoblike or irregular benchlike local topography. The soils developed in this shale are clayey in texture.

Outwash is a mixture of sand and gravel laid down by waters flowing from the melting ice. Outwash mantled with loess or loam alluvium is the principal soil parent material in soil area E, figure 3.

Alluvium is a mixture composed mainly of sand, silt, and clay deposited by moving water. It is found in all areas of the county along streams, but it occurs most extensively along the Missouri River.

Notes on the Surface Geology

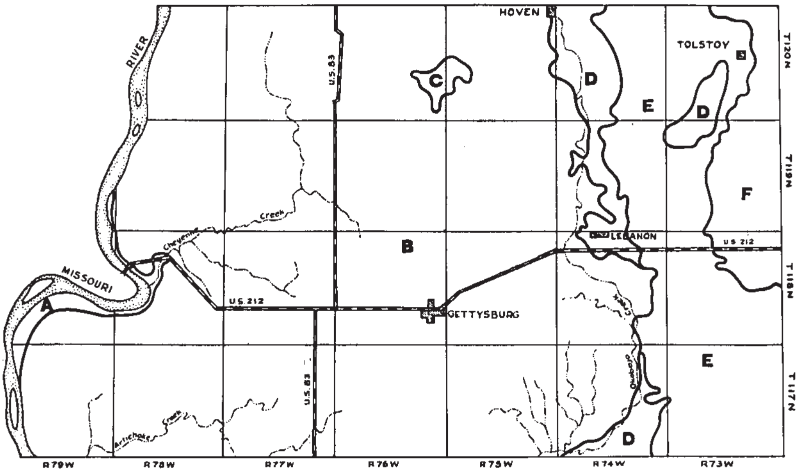
Differences among Potter County soils due to parent material are probably more important than differences due to climate and vegetation. The general nature of the soil parent materials is closely related to the surface geology which is considered briefly in this section.

All of Potter County has been glaciated. In a dissected belt closely paralleling the Missouri River, however, the drift subsequently has been removed by geologic erosion. Exposed along this dissected belt and underlying the drift in the rest of the county, the uppermost bedrock formation is the Pierre shale.

According to Flint[1] the Missouri River was forced into existence by glacial ice which terminated the large east flowing streams and diverted their waters southward. The former course of the Cheyenne River is thought to be through Potter County and is marked by a broad shallow sag extending from the present mouth of the Little Cheyenne River north-eastward to Hoven (see figure 4). At Hoven the pre-glacial Moreau River joined with the pre-glacial Cheyenne River and their combined waters flowed east to the present James Basin and thence northward.

Pleistocene deposits of Potter County as correlated by Flint are shown in figure 4. (The delineation boundaries are plotted from soil boundaries.) The oldest exposed drift has been correlated as Iowan-Tazewell undifferentiated. This drift occupies the central upland area of the county and for the most part consists of loess mantled till.

[1]Flint, R. F., "1954 Pleistocene Geology of Eastern South Dakota," USGS Prof. Paper No. 262.



A Alluvium
B Iowan and Tazewell Drift (not differentiated)
C Glacial Lake Sediments
D Outwash
E Glacial Drift: Cary Substage
F Glacial Drift: Mankato Substage

Figure 4. Pleistocene deposits of Potter County[2]

This area has swell-and-swale topography.

The end moraines of the Cary and Mankato ice sheets compose a belt of hilly land in eastern Potter County. This belt, which is about 6 miles wide, trends nearly north-south and is concave toward the west. In the northern part of the county the morainal area splits with one prong extending to the northeast corner of the county and the other leaving the county just east of Hoven. Between these two prongs and west of the belt of moraines there is an area of outwash, some of which is loess mantled.

The Missouri River trench has been cut in the Pierre shale formation. A loess mantles the rather high dissected benches adjacent to the bluff, and in places it covers the tabular divides of the highland itself. Judging by the young soil developing in it, this loess is very recent.

Climate

The climate of Potter County is characterized by extremes and irregularity throughout the four seasons. Spring is moist, cool, and windy; summer is sunny, warm, and usually fairly dry; autumn is dry, cool, and sunny; and winter is cold and relatively long.

The climatic factors discussed in this bulletin are preciptation and temperature. The climatic growing conditions in any one year depend largely upon the relationship between these two factors.

Table 1 lists the precipitation data and table 2 presents the temperature data applicable to the Potter County area. Temperature and precipitation data are reported at weekly intervals. In table 1 the average weekly precipitation including the inches of new snow is shown. In addition the chances, based on past records, for receiving showers of three intensities are given.

In table 2, the averages of the weekly maximum, mean, and minimum temperatures are given, along with the chances for receiving a maximum temperature of 90°, a maximum temperature of 32°, a minimum temperature of 32°, and a minimum temperature of 0°. Thus for the week of March 29-April 4, the chances are 1 in 3 of receiving a shower of 0.1-0.39 inches of rainfall; 1 in 7 for a shower of 0.4-0.99 inches; and 1 in 44 for a shower of 1 inch and over. During this same week the average of the weekly maximum temperatures was 49.9°, the average of the weekly means was 37.7°, and the average of the weekly minimum temperatures was 26.7°. The chances are 1 in 11 that the maximum temperature will be 32°, 1 in 1.3 that the minimum temperature will be 32°, and 1 in 150 that the minimum temperature will be 0°.

Tables 1 and 2 bring out further that the hottest period of the year is during the 2 weeks, July 19-August 1. During these 2 weeks the chances are 1 in 2 that the temperature will be 90° or above. This hot period follows by about 3 weeks the wettest period of the year, which is during the weeks of May 31-June 27. During this latter period the chances are nearly 1 in 1 of receiving a shower averaging 0.1-0.39 inch and 1 in 2 of receiving a shower of 0.4-0.99 inch of rainfall. Thus adequate rainfall is usually available for small grains providing the variety is one which matures before the middle of July.

Native Vegetation

Potter County lies in an area where short and mid grasses were the dominant native vegetation of the uplands and terraces. On the flood plains of the Missouri River, trees, due to a high water table, grow naturally in this otherwise treeless landscape.

On loams, clay loams, silt loams, and silty clay loams, on undulating, sloping, and rolling uplands, the short and mid grass associations occurred. Included species were blue grama grass, buffalograss, green needlegrass, needle and thread grass, and sideoats grama. Also present were such forbs as silverleaf scurfpea and silverleaf sage.

On the clay soils western wheatgrass, buffalograss, and blue grama grass were dominant.

The hilly loam and clay loam soils were short grass sites and consisted principally of stands of buffalograss and blue grama grass.

The poorly drained soils were the habitat for rushes, reeds, and other marshy vegetation.

Table 1. Precipitation Data for North Central South Dakota*

Week	Average Weekly Precipitation in Inches	Based on Past Records, the Chances for Receiving Showers† of: 0.1-0.39" Are:	0.4-0.99" Are:	1" and Over Are:	Average Weekly New Snow in Inches
Jan. 3-9	0.11	1 in 4	1 in 66	1 in 66	1.09
Jan. 10-16	0.09	1 in 3	1 in 52	----	1.02
Jan. 17-23	0.09	1 in 4	1 in 43	1 in 250	1.10
Jan. 24-30	0.10	1 in 3	1 in 37	1 in 83	1.09
Jan. 31-Feb. 6	0.10	1 in 4	1 in 20	1 in 250	1.15
Feb. 7-13	0.12	1 in 3	1 in 12	----	1.26
Feb. 14-20	0.13	1 in 3	1 in 15	1 in 83	1.50
Feb. 21-27	0.11	1 in 3	1 in 20	----	1.09
Feb. 28-29	0.04	1 in 14	1 in 32	----	0.42
Mar. 1-7	0.14	1 in 3	1 in 11	1 in 250	1.25
Mar. 8-14	0.17	1 in 3	1 in 10	1 in 66	1.34
Mar. 15-21	0.17	1 in 3	1 in 7	1 in 83	1.08
Mar. 22-28	0.32	1 in 1.9	1 in 5	1 in 18	1.68
Mar. 29-Apr. 4	0.23	1 in 3	1 in 7	1 in 44	1.04
April 5-11	0.34	1 in 1.6	1 in 4	1 in 37	1.02
April 12-18	0.39	1 in 1.9	1 in 4	1 in 22	0.38
April 19-25	0.51	1 in 1.5	1 in 3	1 in 15	0.27
April 26-May 2	0.61	1 in 1.3	1 in 3	1 in 8	0.26
May 3-9	0.49	1 in 1.5	1 in 3	1 in 12	0.21
May 10-16	0.49	1 in 1.5	1 in 4	1 in 9	0.04
May 17-23	0.51	1 in 1.2	1 in 3	1 in 14	------
May 24-30	0.77	1 in 1.2	1 in 2	1 in 5	------
May 31-June 6	0.86	1 in 1	1 in 1.6	1 in 7	------
June 7-13	0.77	1 in 1.1	1 in 2	1 in 8	------
June 14-20	0.77	1 in 1.2	1 in 1.8	1 in 6	------
June 21-27	0.80	1 in 1.1	1 in 2	1 in 5	------
June 28-July 4	0.70	1 in 1.4	1 in 3	1 in 5	------
July 5-11	0.51	1 in 1.4	1 in 3	1 in 10	------
July 12-18	0.50	1 in 1.6	1 in 3	1 in 9	------
July 19-25	0.42	1 in 1.6	1 in 4	1 in 14	------
July 26-Aug. 1	0.45	1 in 1.6	1 in 4	1 in 9	------
Aug. 2-8	0.60	1 in 1.4	1 in 3	1 in 8	------
Aug. 9-15	0.55	1 in 1.5	1 in 3	1 in 8	------
Aug. 16-22	0.50	1 in 1.9	1 in 3	1 in 11	------
Aug. 23-29	0.40	1 in 1.9	1 in 5	1 in 11	------
Aug. 30-Sept. 5	0.31	1 in 2	1 in 7	1 in 14	------
Sept. 6-12	0.48	1 in 1.8	1 in 3	1 in 9	------
Sept. 13-19	0.32	1 in 2	1 in 4	1 in 24	0.01
Sept. 20-26	0.30	1 in 2	1 in 5	1 in 24	0.00
Sept. 27-Oct. 3	0.27	1 in 2	1 in 7	1 in 18	0.02
Oct. 4-10	0.33	1 in 1.9	1 in 7	1 in 13	0.02
Oct. 11-17	0.18	1 in 4	1 in 8	1 in 37	0.04
Oct. 18-24	0.24	1 in 2	1 in 7	1 in 43	0.27
Oct. 25-31	0.21	1 in 3	1 in 10	1 in 26	0.67
Nov. 1-7	0.16	1 in 4	1 in 8	1 in 83	0.57
Nov. 8-14	0.13	1 in 3	1 in 14	1 in 124	0.86
Nov. 15-21	0.11	1 in 4	1 in 24	1 in 83	0.86
Nov. 22-28	0.10	1 in 4	1 in 24	1 in 83	0.70
Nov. 29-Dec. 5	0.11	1 in 4	1 in 14	----	0.83
Dec. 6-12	0.10	1 in 4	1 in 24	1 in 250	0.92
Dec. 13-19	0.07	1 in 4	1 in 66	----	0.81
Dec. 20-26	0.09	1 in 3	1 in 52	1 in 83	1.05
Dec. 27-Jan. 2	0.05	1 in 3	1 in 27	----	1.10
Yearly Average	**18.42**				**27.02**

*Summary of about 53 years data from five reporting stations (Eureka—McPherson County, Pierre—Hughes County, Highmore—Hyde County, Miller—Hand County, Faulkton—Faulk County).

Data compiled with the assistance of R. F. Pengra, Agricultural Economics Department; M. D. Magnuson, U. S. Weather Bureau; and C. Lindler, Machine Records Service, from I.B.M. cards under a joint project by the South Dakota State College Experiment Station, the U.S. Reclamation Bureau, and the U.S. Weather Bureau.

†Includes both rain and snow showers.

Table 2. Temperature Data for North Central South Dakota*

Week	Average of Weekly Maximum Temperatures in Degrees F.	Average of Weekly Mean Temperatures in Degrees F.	Average of Weekly Minimum Temperatures in Degrees F.	Based on Past Records the Chances for Receiving A Maximum Temperautre of 90°F. Are:	A Maximum Temperature of 32°F. Are:	A Minimum Temperature of 32°F. Are:	A Minimum Temperature of 0°F. Are:
Jan. 3-9	25.1	14.31	3.79	----------	1 in 1.6	1 in 1	1 in 2
Jan. 10-16	25.3	14.56	4.16	----------	1 in 1.6	1 in 1	1 in 2
Jan. 17-23	25.1	14.08	3.33	----------	1 in 1.6	1 in 1	1 in 2
Jan. 24-30	23.3	12.31	1.64	----------	1 in 1.5	1 in 1	1 in 2
Jan. 31-Feb. 6	24.5	13.42	2.79	----------	1 in 1.5	1 in 1	1 in 2
Feb. 7-13	26.1	15.38	5.22	----------	1 in 1.7	1 in 1	1 in 3
Feb. 14-20	28.4	17.32	6.86	----------	1 in 1.7	1 in 1	1 in 3
Feb. 21-27	31.3	20.19	9.98	----------	1 in 1.9	1 in 1	1 in 4
Feb. 28-29	33.6	23.13	12.83	----------	1 in 2	1 in 1	1 in 7
Mar. 1-7	34.7	23.73	13.66	----------	1 in 2.5	1 in 1	1 in 6
Mar. 8-14	38.5	27.29	17.10	----------	1 in 3	1 in 1.1	1 in 10
Mar. 15-21	43.0	31.00	20.08	1 in 1700	1 in 5	1 in 1.1	1 in 13
Mar. 22-28	47.2	34.88	23.75	1 in 1700	1 in 7	1 in 1.2	1 in 31
Mar. 29-Apr. 4	49.9	37.73	26.71	----------	1 in 11	1 in 1.3	1 in 150
Apr. 5-11	54.1	41.29	29.51	----------	1 in 29	1 in 1.5	1 in 900
Apr. 12-18	59.4	45.43	32.50	1 in 300	1 in 230	1 in 1.9	----------
Apr. 19-25	62.4	48.54	35.91	1 in 300	1 in 900	1 in 3	----------
Apr. 26-May 2	63.8	50.42	38.19	1 in 55	1 in 900	1 in 4	----------
May 3-9	65.7	52.05	39.54	1 in 30	----------	1 in 4	----------
May 10-16	68.4	54.50	41.72	1 in 38	----------	1 in 6	----------
May 17-23	72.1	58.06	45.25	1 in 20	----------	1 in 17	----------
May 24-30	74.0	60.53	48.26	1 in 16	----------	1 in 33	----------
May 31-June 6	74.2	61.41	50.37	1 in 13	----------	1 in 160	----------
June 7-13	76.1	62.56	51.94	1 in 11	----------	1 in 290	----------
June 14-20	80.0	66.35	55.19	1 in 5	----------	1 in 1700	----------
June 21-27	82.5	68.34	56.52	1 in 4	----------	1 in 900	----------
June 28-July 4	84.2	69.85	58.06	1 in 3	----------	1 in 1700	----------
July 5-11	86.1	71.83	59.49	1 in 3	----------	----------	----------
July 12-18	87.1	72.30	59.47	1 in 2.5	----------	----------	----------
July 19-25	88.7	73.02	59.93	1 in 2	----------	----------	----------
July 26-Aug. 1	88.7	73.14	60.24	1 in 2	----------	----------	----------
Aug. 2-8	87.0	71.83	58.86	1 in 2.5	----------	----------	----------
Aug. 9-15	86.3	71.08	58.31	1 in 2.5	----------	----------	----------
Aug. 16-22	85.5	70.12	57.21	1 in 3	----------	1 in 1700	----------
Aug. 23-29	83.4	67.88	55.37	1 in 4	----------	1 in 220	----------
Aug. 30-Sept. 5	82.4	66.96	53.96	1 in 4	----------	1 in 590	----------
Sept. 6-12	77.8	63.37	51.22	1 in 6	----------	1 in 62	----------
Sept. 13-19	75.5	60.50	47.73	1 in 10	----------	1 in 18	----------
Sept. 20-26	72.1	56.72	43.48	1 in 15	----------	1 in 8	----------
Sept. 27-Oct. 3	70.1	54.68	41.67	1 in 30	----------	1 in 7	----------
Oct. 4-10	67.1	52.12	39.08	1 in 50	----------	1 in 4	----------
Oct. 11-17	65.2	50.25	37.15	1 in 170	1 in 450	1 in 3	----------
Oct. 18-24	59.3	45.25	33.08	1 in 290	1 in 53	1 in 2	1 in 1700
Oct. 25-31	54.8	40.99	29.25	1 in 580	1 in 20	1 in 1.6	1 in 89
Nov. 1-7	50.7	37.61	26.37	----------	1 in 11	1 in 1.3	1 in 78
Nov. 8-14	43.8	32.01	21.86	----------	1 in 5	1 in 1.1	1 in 25
Nov. 15-21	42.3	30.88	21.02	----------	1 in 4	1 in 1.1	1 in 24
Nov. 22-28	39.3	28.03	18.26	----------	1 in 4	1 in 1	1 in 17
Nov. 29-Dec. 5	36.4	25.20	15.12	----------	1 in 3	1 in 1	1 in 8
Dec. 6-12	30.8	20.12	10.25	----------	1 in 2	1 in 1	1 in 4
Dec. 13-19	27.4	17.34	7.73	----------	1 in 1.6	1 in 1	1 in 4
Dec. 20-26	28.4	18.00	8.14	----------	1 in 1.8	1 in 1	1 in 3
Dec. 27-Jan. 2	25.7	14.97	4.48	----------	1 in 1.6	1 in 1	1 in 3
Total	**3,014.8**	**2,324.86**	**1,713.67**				
Yearly Average	**56.9**	**43.9**	**32.3**				

*Summary of about 53 years data from five reporting stations (Eureka—McPherson County, Pierre—Hughes County, Highmore—Hyde County, Miller—Hand County, Faulkton—Faulk County).

Data compiled with the assistance of R. F. Pengra, Agricultural Economics Department; M. D. Magnuson, U. S. Weather Bureau; and C. Lindler, Machine Records Service, from I. B. M. cards under a joint project by the South Dakota State College Experiment Station, the U. S. Reclamation Bureau, and the U. S. Weather Bureau.

Soils

SOILS

POTTER COUNTY soils are discussed under three subheads in this section: (1) Formation of the soils; (2) Soil Series and Their Relationships; and (3) Soil Types and Phases. Under subhead (3) the individual soils are listed alphabetically and described. These descriptions include information on the drainage, consistence, slope, physiographic position, general location in the county, parent material permeability, salts and alkali, stoniness, waterholding capacity, tilth, fertility, erosion hazard, and irrigability. General information on management principles and yield predictions for several defined sets of management practices are given in the section "Soil Management and Productivity."

Formation of the Soils

Soil management knowledge can be applied better with an understanding of the formative processes of the soils. This will aid in explaining why different soils require different management practices.

Soil formation starts with the accumulation of parent material. In Potter County the parent materials are of glacial or residual origin. Chemical weathering of the rock minerals (which continues throughout soil formation) in the parent material releases simple compounds which serve as food for bacteria and fungi. These simple forms of life lived and died by the millions and decayed in the parent material. Thus organic matter began accumulating.

Gradually the developing soil was able to support the higher forms of plant and animal life and it is this source that has contributed most of the present organic matter accumulation. This addition of organic matter changed the upper layers of the parent material. The development of these differing layers or horizons is the beginning of the soil profile.

Table 3. General Characteristics of the Soil Series of Potter County, South Dakota

Soil Series	Parent Material	Physiographic Position	Slope	Natural Drainage	General Profile Texture	Subsoil Consistence
Agar	Loess or Loess/* Glacial till	Upland	Gently sloping	Well	Medium or Medium over medium fine	Friable
Akaska	Loess/outwash	Outwash Plain	Nearly level	Well	Medium/coarse	Friable
Crandon	Drift/outwash.	Morainic Upland	Steep	Excessive	Coarse	Loose
Estevan	Glacial till	Upland Depressions	Level	Imperfect	Moderately fine	Compact
Hoven	Local alluvium	Depressions & Channels	Level	Imperfect	Moderately fine	Compact
Hurley	Glacio-residual, residual, or local alluvium	Depressions	Level	Imperfect	Fine	Compact
Joe Creek	Loess/Glacial till or shale	Upland and Terrace	Nearly level	Well	Medium	Friable
Lismas	Shale	Upland	Steep	Excessive	Fine	Firm
Northville	Old alluvium	Terrace and Floodplain	Level	Imperfect	Moderately fine	Compact
Oahe	Outwash	Outwash Plain	Nearly level	Well	Medium/coarse	Friable
Orman	Colluvial-Alluvial	Terrace	Level	Imperfect	Fine	Firm
Pierre	Shale	Upland	Undulating to steep	Well	Fine	Firm
Promise	Glacio-residual, or Residual	Upland	Undulating	Well	Fine	Firm
Raber	Glacial till	Upland	Undulating	Well	Moderately fine	Firm
Sage	Alluvium	Depressions & Channels	Level	Poor	Moderately fine	Firm
Tetonka	Glacial Drift	Depressions	Level	Poor	Moderately fine	Firm
Williams	Glacial till	Upland	Undulating	Well	Medium	Friable to firm
Zahl	Glacial till	Upland	Steep	Excessive	Medium	Friable

*Diagonals indicate first material is found over the second.

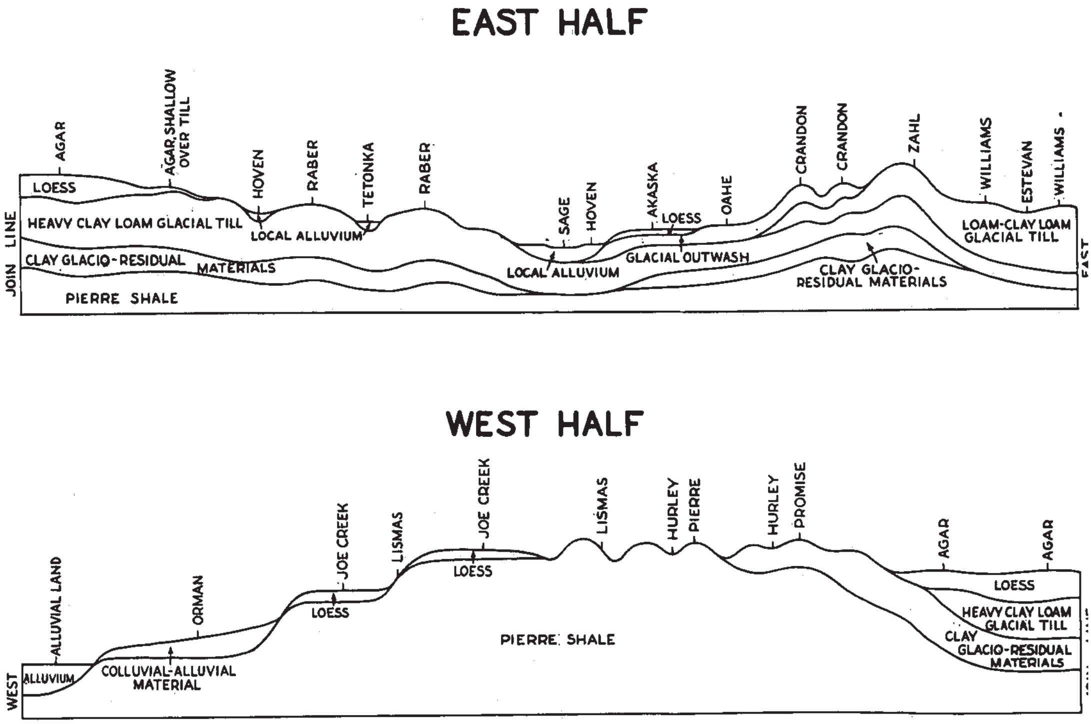


Figure 5. Physiographic position and parent materials of the soil series of Potter County

A soil profile consists of a succession of layers or horizons in a vertical section down through the soil. The boundaries between horizons are usually not sharp although well defined boundaries do occur. The uppermost layer is the A horizon, commonly called the surface soil; the second layer is the B horizon, sometimes called the subsoil; and the third is the C horizon, often called the parent material.

The lower part of the B horizon and or the upper part of the C horizon in Potter County soils is enriched with calcium carbonate leached from the A and upper B horizons. These carbonate-enriched layers are called the horizons of calcium carbonate accumulation and are designated B_{ca} or C_{ca}. The subscript $_{ca}$ refers to calcium carbonate.

The major A, B, and C horizons may be subdivided by using subscripts such as A_1 and A_2. Principal horizons and subscripts used for Potter County soils are, A_1 (the horizon of maximum organic matter accumulation), A_2 (a light gray leached layer found in claypan soils), B_1 (a transition horizon between the A and B but more like the

B than the A), B_2 (horizon of maximum structural development), and the B_{ca} and C_{ca} horizons which have been described in the foregoing paragraph. All of these horizons do not occur in all soils.

The steps of soil formation, mentioned earlier, occur in every soil. The processes operating in each of the three steps differ however, from place to place. If the parent material is sandy, the soil developed in it has different properties than a soil developed in clay. Similarly soils developed in different climatic regions, or under different vegetation, or on different topographic positions, will not be the same.

The nature of soils is determined by the influence of climate, vegetation, parent material, topography, or age (the time interval soils have been developing). Climate and vegetation usually cause regional differences such as between South Dakota and Ohio. Local differences, such as those among the soils of Potter County, are commonly due to differences in parent material, topography, and age.

Soil Series and Their Relationships

The principal characteristics of the soil series of Potter County are shown in table 3. This table and the diagram (figure 5) showing their physiographic position and parent materials bring out the interrelationships of the soil series in the county.

Associations of Soil Series and Types

In the following pages the soils which appear on the map are described in alphabetical order. The colors used refer to the color of the moist soil. The slope terminology used in this report is explained in figure 6. The terms used to describe long simple slopes such as occur on the loess mantled areas of the county are: nearly level, gently sloping, and sloping. The terms used to describe complex slopes which consist of a series of short slopes occurring as rises, knobs, and hills on an undulating or rolling terrain such as a till plain, are: nearly level, gently undulating, undulating, rolling, hilly, and steep.

Principal features and qualities of the types and phases are given in the soil description. In the section of the report entitled, "Soil management and Productivity," the soils are grouped and yield predictions are made for selected management systems and general management practices and principles which apply to all soils are discussed. The acreage and proportionate extent of the soils shown on the soil map are given in table 4.

Table 4. Acreage and Proportionate Extent of Soil Types and Phases

Map Number	Soil Name	Acreage	Percent
1.	Agar association, nearly level	21,069.6	3.7
2.	Agar association, gently sloping	144,597.7	25.4
3.	Agar association, sloping	76,813.0	13.5
4.	Agar association, rolling	16,277.4	2.9
5.	Agar-Lismas association, undulating and steep	2,427.5	0.4
6.	Agar-Raber association, undulating	17,778.6	3.1
7.	Agar, shallow over till-Raber association, hilly	24,254.7	4.3
8.	Agar, shallow over till-Zahl association, hilly	6,675.0	1.2
9.	Akaska association, nearly level	6,964.8	1.2
10.	Akaska association, gently undulating	13,982.0	2.5
11.	Akaska association, undulating	4,495.8	0.8
12.	Crandon association, hilly	2,287.7	0.4
13.	Estevan-Raber association, undulating	1,146.8	0.2
14.	Hoven association	1,801.8	0.3
15.	Hoven-Sage association	6,598.6	1.2
16.	Hurley association, nearly level	1,446.8	0.2
17.	Joe Creek-Lismas association, undulating and steep	4,306.1	0.8
18.	Northville association	2,662.2	0.5
19.	Oahe association, undulating	4,819.4	0.8
20.	Orman association, gently sloping	1,000.0	0.2
21.	Pierre-Lismas association, steep	52,732.2	9.3
22.	Promise association, undulating	4,317.2	0.8
23.	Promise association, hilly	2,877.2	0.5
24.	Promise-Hurley association, undulating	10,185.8	1.8
25.	Promise-Hurley association, hilly	10,877.8	1.9
26.	Promise-Pierre association, hilly	2,359.2	0.4
27.	Raber-Agar, shallow over till, association, undulating	3,769.9	0.7
28.	Raber-Agar, shallow over till, association, hilly	3,125.4	0.5
29.	Raber-Agar-Estevan association, hilly	4,834.4	0.8
30.	Tetonka-Hoven association	11,861.8	2.0
31.	Williams association, gently undulating	4,477.7	0.8
32.	Williams association, undulating	17,582.6	3.1
33.	Williams-Crandon association, hilly	4,430.9	0.8
34.	Williams-Zahl association, hilly	66,844.6	11.8
35.	Alluvial land	4,782.6	0.8
	Lakes	1,780.4	0.3
	Gravel pits	35.0	0.1
	Total	**568,320.0**	**100.0**

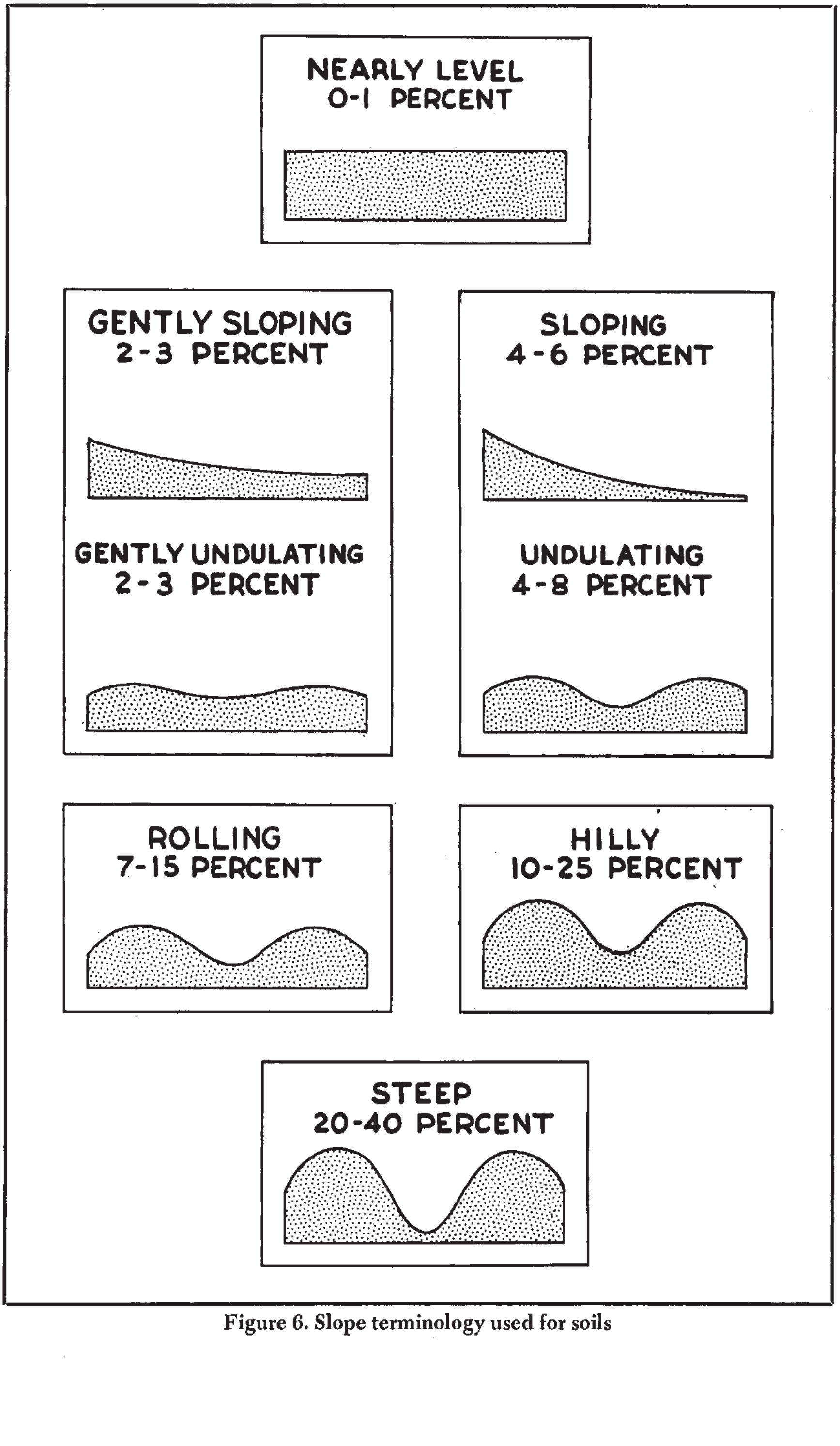


Figure 6. Slope terminology used for soils

No. 1. Agar Association, Nearly Level

This association is composed of well drained, friable, silt loam soils developed in deep and moderately deep loess. It occurs on level and nearly level upland positions in soil area D, figure 3. A large percentage of the profiles in this unit have a thicker solum than the modal Agar described and pictured in unit No. 2, figure 7. No stones occur on or in these soils.

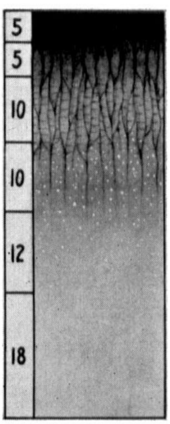
These soils have good tilth and water holding capacity and are not usually susceptible to wind or water erosion.

No. 2. Agar Association, Gently Sloping

This association is composed of well drained, friable, silt loam soils developed in deep loess. It occurs on the gently sloping positions in soil area D, figure 3. This unit is composed largely of the modal Agar silt loam, although some of the thick solum Agar occurs on the footslopes and in the upland drainageways. No stones occur on or in these soils.

These soils have good tilth and water holding capacity and are not usually susceptible to wind or water erosion.

Figure 7. Agar Silt Loam



A_1 0-5″ Very dark brown, very friable silt loam of moderate, fine crumb structure.

B_1 5-10″ Very dark grayish-brown, friable silt loam of moderate, medium prismatic structure.

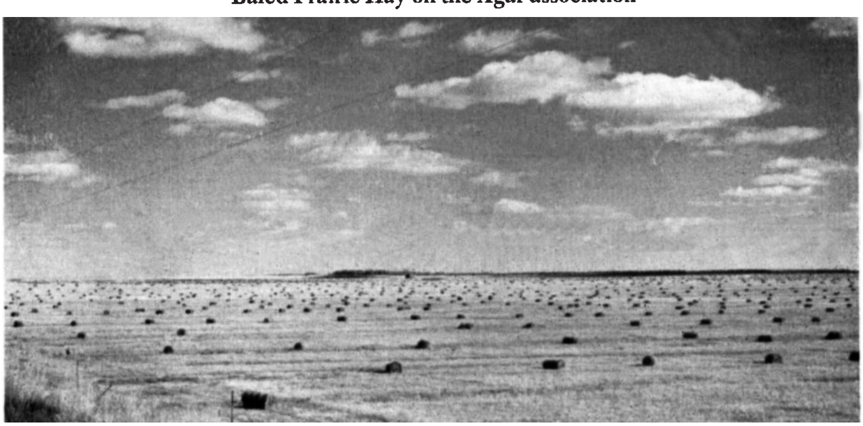
B_2 10-20″ Olive brown, friable silt loam of moderate, medium and fine prismatic-blocky structure.

B_{3ca} 20-30″ Dark grayish-brown, friable, calcareous silt loam of moderate, coarse prismatic structure.

C_{ca} 30-42″ Grayish-brown, friable, calcareous silt loam.

C 42-60″ Grayish-brown, friable, weakly calcareous silt loam.

Baled Prairie Hay on the Agar association



No. 3. Agar Association, Sloping

This association is composed of well drained, friable, silt loam soils developed in deep and moderately deep loess. It occurs on the sloping positions in soil area D, figure 3. This unit is composed largely of modal Agar silt loam, described and pictured in unit No. 2, figure 7. A small percentage of thick solum Agar mentioned in unit No. 1 occurs on the footslopes and in the upland drainageways. A large percentage of Agar silt loam, shallow to till, described and pictured in unit No. 7, figure 10, occurs on the sharp rises and knolls in the unit. No stones occur on or in the soils developed in the deeper loess. In the profiles that are shallow to the till some stones may occur.

These soils have good tilth and water holding capacity. They are not usually susceptible to wind erosion but are subject to some water erosion if control measures are not used.

No. 4. Agar Association, Rolling

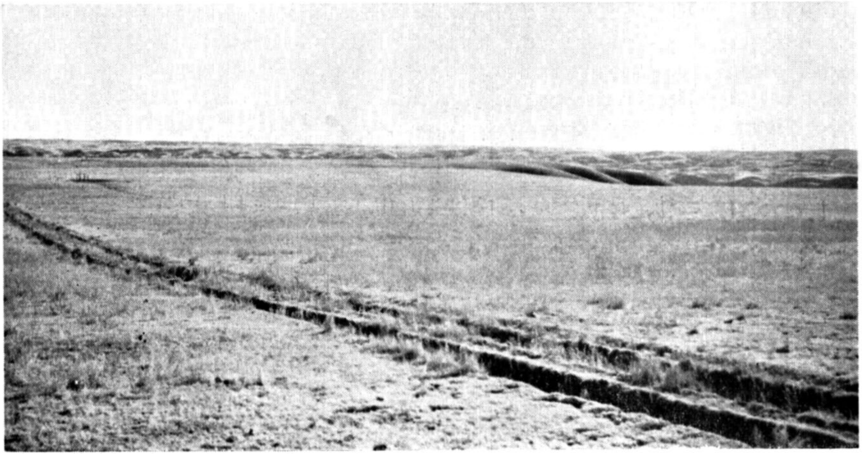
This association is composed of well drained, friable, silt loam soils developed in deep and moderately deep loess. It occurs on the rolling positions in soil area D, figure 3. The largest percentage of this unit is modal Agar silt loam as described in unit No. 2, figure 7. Some thick solum Agar, mentioned in unit No. 1, occurs on the footslopes and in the upland drainageways. A somewhat larger percentage of Agar silt loam, shallow over till, described and pictured in unit No. 7, figure 10, occurs on the sharp rises and knolls of the rolling topography. No stones occur on or in the soils developed in the deeper loess. In the profiles that are shallow to till some stones may occur.

These soils have good tilth and water holding capacity and are not usually susceptible to wind erosion. They are subject to rather severe water erosion if control measures are not used.

No. 5. Agar-Lismas Association, Undulating and Steep

This unit is an association of two soils—the Agar soil and the Lismas soil. It occurs mainly in soil area B, figure 3. The Agar soils are well drained, friable, silt loam soils developed in deep and moderately deep loess. In this association they occur on rather broad, undulating, tabular divides and consist primarily of the modal Agar silt loam described and pictured in unit No. 2, figure 7, although some Agar silt loam, shallow to shale or till, described in unit No. 7, figure 10, does occur.

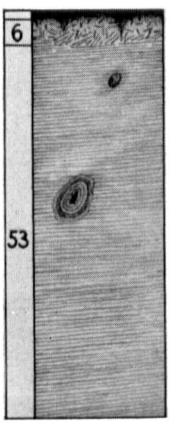
The Lismas soils are very shallow, excessively drained, firm, clay soils developed in heavy shales. In this association they occur on the steep slopes down from the tabular divides to the deeply entrenched drainage stems. This association is composed of about 70 percent Agar soils and 30 percent Lismas soils. Both soils are stone free although manganese dioxide concretions are common on and in the Lismas soils.



Agar soils in native pasture. Lismas soils on the breaks in the background.

The Agar soils in this association have good tilth and water holding capacity. They are not usually subject to wind erosion but are subject to some water erosion if control measures are not taken. The Lismas soils have poor tilth and water intake due to their heavy texture and slope characteristics.

Figure 8. Lismas Clay



A_{11} 0-1″ Grayish-brown, friable, silty mulch.
A_{12} 1-6″ Grayish-brown, firm, partly decomposed, clay shale.

D 6-60″+ Gray, bedded, clay shale.

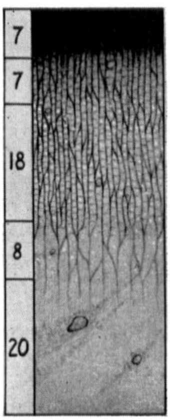
No. 6. Agar-Raber Association, Undulating

This unit is an association of two soils—the Agar soil and the Raber soil. It occurs in soil area D, figure 3. The Agar soils are well drained, friable, silt loam soils developed in deep and moderately deep loess. In this association they occur on the slopes and footslopes of the undulations. About squal amounts of modal Agar silt loam, described in unit No. 2, figure 7, and Agar silt loam, shallow to till, described and pictured in unit No. 7, figure 10, make up the Agar soils of this unit.

The Raber soils are well drained, firm, clay loam soils developed in glacial till. In this association Raber loam occurs on the sharp rises and knolls where the loess mantle is absent. The Agar soils are relatively stone free but the Raber soils have stones scattered freely throughout the profile. This association is composed of about 80 percent Agar soils and 20 percent Raber soils.

The soils in this association have good tilth and water holding capacity They are not usually susceptible to wind erosion but they are subject to slight water erosion if control measures are not used.

Figure 9. Raber Loam



A_1 0-7" Very dark gray, friable loam of weak, coarse prismatic structure.

B_2 7-14" Very dark grayish-brown, firm, heavy clay loam of strong, fine, and medium prismatic-blocky structure.

B_{3ca} 14-32" Dark grayish-brown, firm, strongly calcareous, heavy clay loam of strong, fine and medium prismatic-blocky structure.

C_{ca} 32-40" Gray, firm, strongly calcareous, heavy clay loam of weak, coarse prismatic structure.

C 40-60" Gray, firm, calcareous, heavy clay loam.

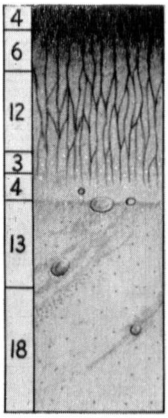
No. 7. Agar, Shallow Over Till-Raber Association, Hilly

This unit is an association of two soils—the Agar soil and the Raber soil. It occurs in soil area D, figure 3. The Agar soils are well drained, friable, silt loam soils developed in deep and moderately deep loess. In this association they occur on the lower slopes of the hilly topography of the unit. Agar silt loam, shallow over till is the predominant Agar soil in the unit; although, a lesser amount of modal Agar silt loam, described and pictured in unit No. 2, figure 7, does occur.

Raber loam,. described in unit No. 6, figure 9, is a well drained, firm, clay loam soil developed in glacial till. In this association its primary occurrence is on the loess free crests and upper side slopes of the hilly relief. The Agar soils are relatively stone free, but the Raber soils have stones scattered throughout the profile. This association is composed of about 75 percent Agar soils and 25 percent Raber soils.

Soils in this association have good tilth and water holding capacity. They are not usually susceptible to wind erosion but they do erode quite severely from water if control measures are not used.

Figure 10. Agar Silt Loam, Shallow Over Till



A_1 0-4" Black, very friable silt loam of weak, fine granular structure.

AB 4-10" Black, friable silt loam of moderate, medium and coarse prismatic-blocky structure.

B_2 10-22" Dark grayish-brown, friable silty clay loam of moderate, medium and fine prismatic-blocky structure.

B_{3ca} 22-25" Dark grayish-brown, friable, calcareous silty clay loam of moderate, medium and fine prismatic structure.

C_{ca} 25-29" Light olive brown, friable silty clay.

D_{ca} 29-42" Dark grayish-brown, friable, calcareous, loam glacial till.

D 42-60" Grayish-brown, firm, calcareous, clay loam glacial till.

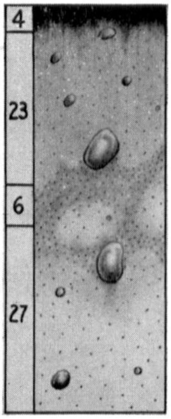
No. 8. Agar, Shallow Over Till-Zahl Association, Hilly

This unit is an association of three soils—the Agar soil, the Raber soil, and the Zahl soil. It occurs in soil area D, figure 3. The Agar soils are well drained, friable, silt loam soils developed in deep and moderately deep loess. In this association they occur on the lower slopes of the hilly topography of the unit. The Agar silt loam, shallow over till, described and pictured in unit No. 7, figure 10, comprises practically all of the Agar soils in this unit. The Raber loam, described and pictured in unit No. 6, figure 9, is a well drained, firm, clay loam soil developed in glacial till. In this association its occurrence is on the smoother of the loess free crests and upper side slopes of the hilly relief.

The Zahl loam is an excessively drained, very shallow, friable loam or clay loam soil developed in glacial till. In this association it occurs on the steeper, loess free knobs and upper side slopes of the hilly topography. Agar soils are relatively stone free, although in much of this area glacial boulders may be found on the surface of these soils. Raber and Zahl soils have stones and boulders scattered throughout the profile. This association is composed of about 60 percent Agar soils, 30 percent Raber soils, and 10 percent Zahl soils.

The Agar and Raber soils in this association have good tilth and water holding capacity. The Zahl soils have only fair tilth and a poor water intake rate due to the character of the topography on which they occur. Soils in this association are not usually susceptible to wind erosion but are subject to rather severe water erosion if control measure are not used.

Figure 11. Zahl Loam



A_1 0-4" Very dark gray, very friable, slightly calcareous loam of weak, fine granular structure.

C_{ca11} 4-27" Light olive brown, very friable, strongly calcareous clay loam.

C_{ca12} 27-33" Olive, very friable, calcareous clay loam.

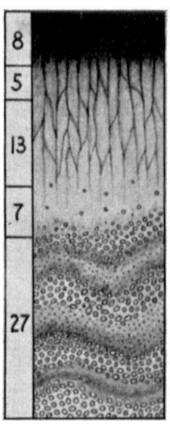
C 33-60" Olive, firm, calcareous clay loam.

No. 9. Akaska Association, Nearly Level

This is an association of well drained, friable, silt loam soils developed in moderately deep loess overlying outwash sands and gravels. It occurs on nearly level outwash plains in soil area E, figure 3. The profile is described and pictured below. The upper part of the profile is relatively stone free.

These soils have good tilth and good to fair water holding capacity depending on the depth to the coarse substratum. They are not usually susceptible to wind or water erosion.

Figure 12. Akaska Silt Loam



A_1 0-8" Very dark gray, friable silt loam of weak, fine granular structure.

B_2 8-13" Very dark grayish-brown, friable silty clay loam of moderate, medium prismatic-blocky structure.

B_3 13-26" Olive brown, friable silty clay loam of weak, medium prismatic to massive structure.

CD_{ca} 26-33" Light olive brown, friable, calcareous sandy clay loam.

D 33-60" Light yellowish-brown, loose, outwash sand and gravel.

No. 10. Akaska Association, Gently Undulating

This is an association of well drained, friable, silt loam soils developed in moderately deep loess overlying outwash sands and gravels. It occurs on gently undulating outwash plains in soil area E, figure 3. The profile is as described and pictured in unit No. 9, figure 12. The upper part of the profile is relatively stone free.

These soils have good tilth and good to fair water holding capacity depending on the depth to the coarse substratum. They are not usually susceptible to wind erosion and are only subject to slight water erosion.

No. 11. Akaska Association, Undulating

This association is composed of well drained, friable, silt loam soils developed in moderately deep loess overlying outwash sands and gravels. It occurs on undulating outwash plains in soil area E, figure 3 The profile is as described and pictured in unit No. 9, figure 12. The upper part of the profile is relatively stone free.

These soils have good tilth and good to fair water holding capacity depending on the depth to the coarse substratum. They are usually not susceptible to wind erosion but are susceptible to water erosion unless measures are taken to control runoff.

No. 12. Crandon Association, Hilly

This is an association of predominantly excessively drained, shallow, loose, sandy and gravelly soils developed in thin glacial drift over morainic outwash. It occurs on hilly or morainic topography in soil area F, figure 3. The profile is described and pictured below. Some Williams soils, described and pictured in unit No. 31, figure 25, also occur in this unit on the smoother portions of the landscape.

These soils have fair tilth and poor water holding capacity. They are susceptible to some surface blowing if not in grass but are not usually susceptible to water erosion due to the coarseness of the materials.

Crandon soils on gravelly ridge

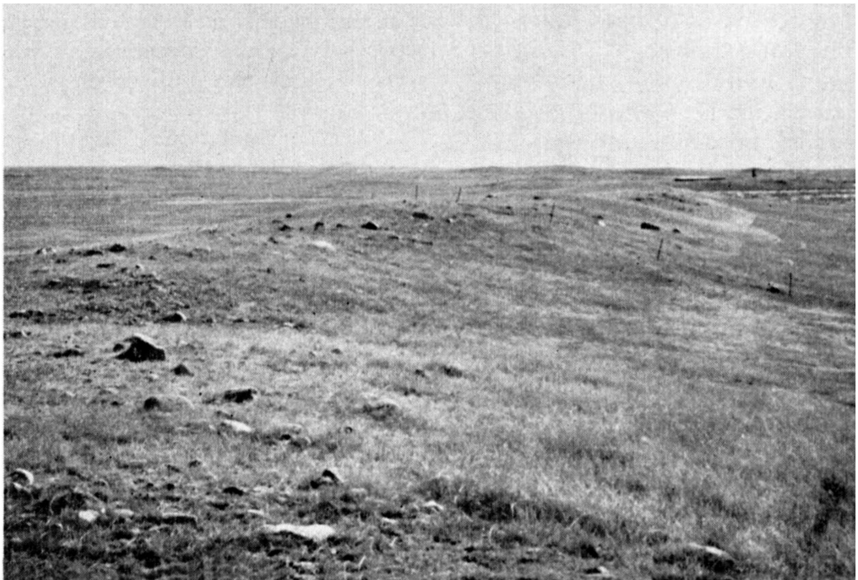
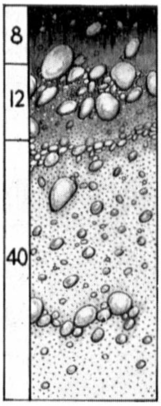


Figure 13. Crandon Sandy Loam



A_1 0-8″ Very dark gray, very friable, slightly calcareous sandy loam of weak, fine granular structure.

C_{ca} 8-20″ Multi-colored, strongly calcareous, loose, morainic outwash.

C 20-60″ Multi-colored, slightly calcareous, clean, loose, sand and gravel, morainic outwash.

No. 13. Estevan-Raber Association, Undulating

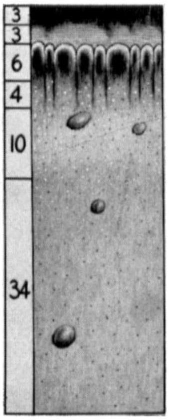
This unit is an association of three soils—the Estevan soil, the Raber soil, and the Agar soil. It occurs in soil area D, figure 3. The Estevan loam soils are imperfectly drained, compact, claypan soils developed in glacial till. In this association they occur on the flats and in the microrelief pockets on the macro-slopes of the loess-free portions of the undulating topography of this unit.

The Raber loam soils, described and pictured in unit No. 6, figure 9, are well drained, firm, clay loam soils developed in glacial till. In this association their occurrence is on the areas of the loess-free portions of the macro-slopes not occupied by the microrelief pockets in which the Estevan soils occur. The Agar soils are well drained, friable, silt loam soils developed in deep and moderately deep loess. In this association they occur in a rather patchy pattern over the landscape with no definite positional occurrence.

The Agar silt loam, shallow over till, described and pictured in unit No. 7, figure 10, comprises practically all of the Agar soils in this association. The upper horizons of the Agar soils are relatively stone free, but the Raber and Estevan soils have stones scattered throughout their profiles. This association is composed of about 55 percent Estevan soils, 25 percent Raber soils, and 20 percent Agar soils.

The Agar and Raber soils in this association have good tilth and water holding capacity. The Estevan soils have poor tilth and poor drainage. The soils in this association are not usually susceptible to wind erosion. The Estevan soils are not usually subject to water erosion but the Agar and Raber soils in this association are subject to slight water erosion if measures for control are not taken.

Figure 14. Estevan Loam



A_1 0-2½" Black, very friable silt loam of weak, fine granular structure.

A_2 2½-6" Grayish-brown (dry), very friable silty clay loam of moderate, coarse prismatic to moderate, fine platy structure.

B_2 6-12" Very dark grayish-brown, very firm clay loam of strong, medium and coarse columnar to medium and fine blocky structure.

B_{3ca} 12-16" Olive brown, very firm, strongly calcareous silty clay loam of moderate, medium prismatic-blocky structure.

C_{ca} 16-26" Light olive brown, firm, strongly calcareous silty clay.

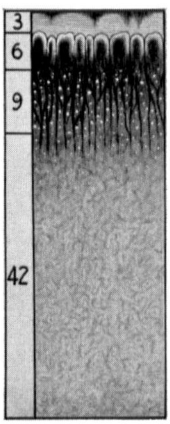
C_2 26-60" Dark gray, firm, calcareous silty clay.

No. 14. Hoven Association

This is an association of imperfectly drained, compact, claypan soils developed in local alluvium. In this unit it occurs in closed clay basins or depressions in soil area D, figure 3. The profile is described and pictured below.

These soils have poor tilth and restricted drainage. They are not usually susceptible to wind or water erosion.

Figure 15. Hoven Silty Clay Loam



A_2 0-3" Light gray (dry), very friable silty clay loam of weak, fine platy structure.

B_2 3-9" Very dark gray, very firm silty clay of strong, medium columnar to moderate, medium and fine prismatic-angular blocky structure.

B_{3s} 9-18" Very dark gray, very firm, calcareous silty clay of weak, angular-blocky structure. Salts common.

C_1 18-60" Very dark gray, firm, calcareous silty clay.

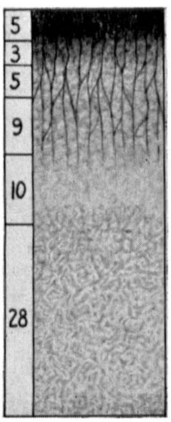
No. 15. Hoven-Sage Association

This unit is an association of two soils—the Hoven soil and the Sage soil. It occurs in soil area D, figure 3. The Hoven silty clay loam, as decribed and pictured in unit 14, figure 15, is an imperfectly drained, compact, claypan soil developed in local alluvium. In this association it occurs in microrelief pockets on broad, nearly level, glacial melt water channels.

The Sage silty clay loam is a poorly drained, firm, salty soil developed in alluvium. In this association it occurs in areas on broad, nearly level, glacial melt water channels that are influenced by a high seasonal water table. Salts are commonly found concentrated by evaporation on the surface of the Sage soils. This association is composed of about 50 percent Hoven soils and 50 percent Sage soils.

The soils in this association have poor tilth and are extremely susceptible to puddling. They are not usually subject to wind or water erosion.

Figure 16. Sage Silty Clay Loam



A_1 0-5" Black, friable silt loam of weak, fine granular structure.

B_2 5-8" Very dark gray, firm silty clay of weak, medium prismatic-blocky structure.

B_{2gca} 8-13" Grayish-brown, firm, strongly calcareous silty clay of moderate, medium to fine prismatic-blocky structure.

B_{3gca} 13-22" Dark grayish-brown, firm, strongly calcareous silty clay of weak, medium prismatic structure.

C_{gca} 22-32" Light brownish-gray, firm, strongly calcareous silty clay.

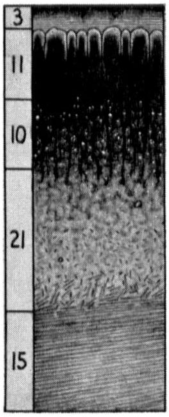
C_{gs} 32-60" Strongly mottled, olive yellow, firm, calcareous clay loam. Salts common.

No. 16. Hurley Association, Nearly Level

This is an association of imperfectly drained, compact, claypan soils developed in glacio-residual or residual materials, or local alluvium from these materials. It occurs in slight swales, on flats, and in the microrelief pockets on upland slopes. In this unit it occurs in slight swales and on flats in soil areas B and C, figure 3. The profile is described and pictured below.

These soils have poor tilth and restricted drainage. They are not usually susceptible to wind or water erosion.

Figure 17. Hurley Silty Clay



A_1-A_2 0-3″ Grayish-brown (dry), friable silty clay of weak, fine platy structure.

B_2 3-14″ Very dark grayish-brown, very firm silty clay of strong, medium columnar structure.

B_{3ca} 14-24″ Very dark grayish-brown, very firm, calcareous clay of weak, coarse prismatic-blocky structure.

C_s 24-45″ Dark grayish-brown mottled with light olive brown, friable, calcareous clay with many shale chips. Segregated salt common.

D 45-60″ Dark grayish-brown, firm, noncalcareous, unweathered bedded shale.

No. 17. Joe Creek-Lismas Association, Undulating and Steep

This unit is an association of two soils—the Joe Creek soil and the Lismas soil. It occurs in soil areas A and B, figure 3. The Joe Creek soils are shallow, well drained, friable, silt loam soils developed in variable depths of loess over various substratum materials. In this association they occur as deep loess or as loess over shale on broad, undulating tabular divides of dissected terraces.

The Lismas soils, described and pictured in unit No. 5, figure 8, are very shallow, excessively drained, clay soils developed in heavy shales. In this association they occur on steep slopes down from the tabular divides to the rather deeply entrenched drainage stems. This association is composed of about 70 percent Joe Creek soils and 30 percent Lismas soils.

Joe Creek soils have good tilth and good water holding capacity in contrast to the Lismas soils which have poor tilth and a poor water intake rate. Both soils in this association are susceptible to water erosion and the Joe Creek is subject to wind erosion if control measures are not used.

Joe Creek-Lismas association. Cattle grazing on Joe Creek soils. Steep soils are lismas.

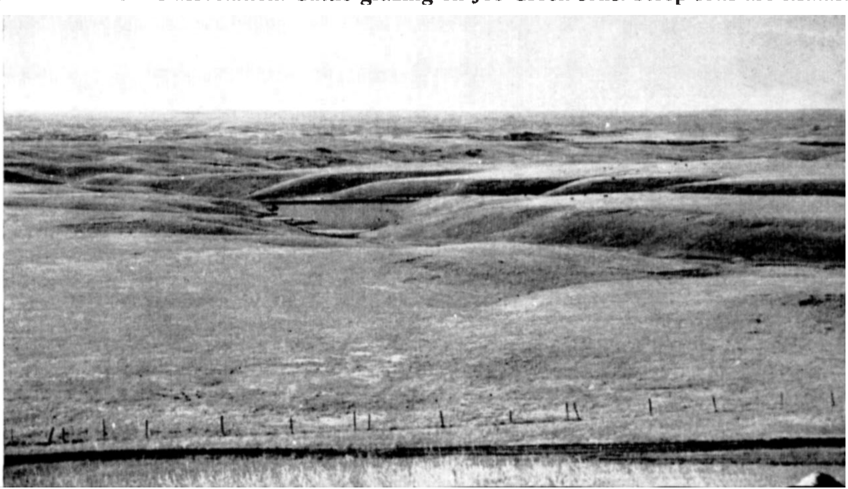
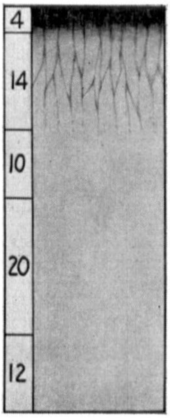


Figure 18. Joe Creek Silt Loam



A_1 0-4″ Dark grayish-brown, very friable silt loam of weak, medium platy structure.

A-C 4-18″ Light olive brown, very friable, slightly calcareous silt loam of weak, very coarse prismatic structure.

C_1 18-28″ Light olive brown, very friable, calcareous silt loam.

C_{ca} 28-48″ Light olive brown, very friable, strongly calcareous silt loam.

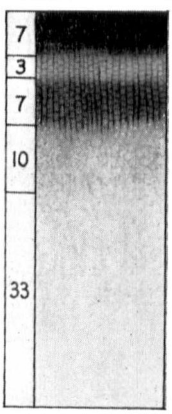
C_2 48-60″ Light olive brown, very friable, calcareous silt loam.

No. 18. Northville Association, Nearly Level

This is an association of imperfectly drained, compact, claypan soils developed in old alluvium. It occurs in soil area D, figure 3, on low, nearly level, flood plain terraces along the preglacial course of the Cheyenne River. The soil profile is described and pictured below.

These soils have fair to poor tilth and a slow water intake rate. They are not usually susceptible to wind or water erosion.

Figure 19. Northville Silty Clay Loam



A_1 0-7″ Black, friable silty clay loam of weak, medium granular structure.

A_2 7-10″ Dark brown, friable silt loam of weak to moderate, fine blocky structure.

B_2 10-17″ Very dark brown, very firm silty clay loam of strong, fine blocky structure.

C_{ca} 17-27″ Olive brown, friable, strongly calcareous silty clay loam. Salts common.

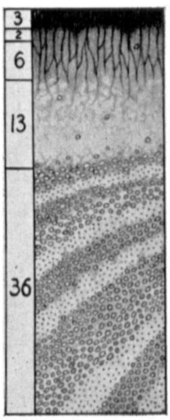
C 27-60″ Light yellowish-brown to olive brown, friable, silt loam or silty clay loam.

No. 19. Oahe Association, Undulating

This is an association of well drained, friable, loam soils developed in loamy outwash materials overlying coarse glacial outwash. It occurs in soil area E, figure 3, on the undulating and very slightly undulating, loess free areas of outwash plains. The soil profile is described and pictured below.

These soils have good tilth but only fair water holding capacity. They are not susceptible to water erosion; however, slight wind erosion may be a problem due to the somewhat drouthy nature of the profile. In some areas, a shallow, perched water table exists seasonally in these soils.

Figure 20. Oahe Loam

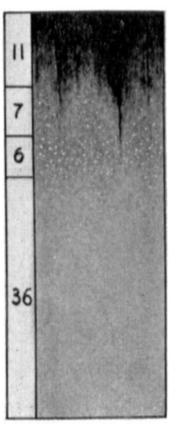


A_1 0-3″ Black, very friable loam of weak, fine granular structure.
B_1 3-5″ Very dark brown, friable loam of weak, medium prismatic-granular structure.
B_2 5-11″ Very dark brown, friable sandy clay loam of moderate, medium prismatic-blocky structure.
C_{gca} 11-24″ Mottled, pale yellow to olive, friable, strongly calcareous sandy clay loam.

C_2 24-60″ Multi-colored, very slightly calcareous, loose sand and gravel outwash.

No. 20. Orman Association, Gently Sloping

Figure 21. Orman Clay



A_1 0-11″ Very dark olive gray, very firm clay.

A-C_{ca} 11-18″ Dark olive gray, very firm, slightly calcareous clay.

C_{ca} 18-24″ Dark olive gray, very firm, calcareous clay.

C 24-60″ Olive gray, very firm clay.

This is an association of imperfectly drained, firm, clay loam soils developed in colluvial-alluvial or local alluvial materials from heavy shales. It occurs on gently sloping terrace positions along the major drainages in soil areas A and B, figure 3.

These soils have poor tilth and a poor water intake rate due to the nature of the heavy-textured materials which also cause extensive surface cracking when the soil is dry. These soils are not usually subject to wind erosion. They are susceptible to rather severe gullying where the upland drainageways dissect the terraces on which they occur.

No. 21. Pierre-Lismas Association, Steep

This unit is an association of two soils—the Pierre soil and the Lismas soil. It occurs in soil area B, figure 3.

Pierre clay soils are well drained, firm, clay soils developed in heavy shales. In this association they occur on the smoother ridges and divides of the landscape.

The Lismas clay soils, as described and pictured in unit No. 5, figure 8, are very shallow, excessively drained, firm, clay soils developed in heavy shales. In this association they occur on the steep slopes down from the smoother ridges, occupied by the Pierre soils, to the deeply entrenched dendritic drainage which characterizes the Pierre plain topography. This association is composed of about 70 percent Pierre soils and 30 percent Lismas soils.

Pierre-Lismas soil association landscape

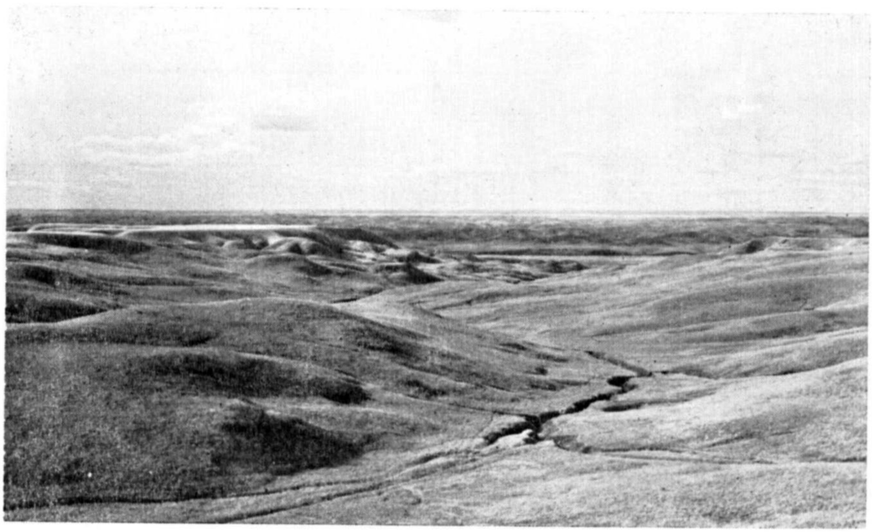
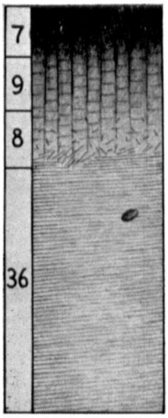


Figure 22. Pierre Clay



A_1 0-7″ Dark olive gray, firm clay of weak, medium blocky structure.

B_2 7-16″ Dark olive brown, firm clay of moderate, coarse blocky structure.

C_1 16-24″ Dark gray, firm clay of weak, coarse blocky or massive structure.

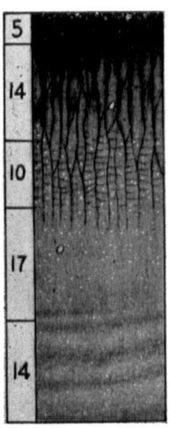
C_2 24-60″ Gray, bedded, clay shale.

No. 22. Promise Association, Undulating

This is an association of well drained, firm, clayey soils developed in glacio-residual or residual materials. It occurs in soil area C, figure 3, on undulating topography. Most of the profiles in this unit are of the modal Promise silty clay type, which show the influence of glaciation only weakly. There is also a small percentage of Promise silty clay soils in this unit which display quite strongly the influence of glacial action on the materials in which they are developed.

These soils have fair to poor tilth and a rather slow water intake rate due to the character of the materials from which they have developed. They are not usually susceptible to wind erosion but are subject to slight water erosion if control measures are not used.

Figure 23. Promise Silty Clay



A_1 0-5″ Very dark gray, firm silty clay of moderate, medium prismatic-subangular blocky structure.

B_2 5-19″ Dark grayish-brown, firm, weakly calcareous clay of moderate, coarse and medium prismatic breaking to very fine blocky structure.

B_{3ca} 19-29″ Very dark grayish-brown, firm, weakly calcareous clay of moderate, coarse and medium blocky structure.

C_s 29-46″ Dark grayish-brown, very firm, calcareous clay. Salt crystals common.

C 46-60″ Banded, black and dark grayish-brown, firm, calcareous silty clay loam.

No. 23. Promise Association, Hilly

This is an association of well drained, firm, clayey soils developed in glacio-residual or residual materials. It occurs in soil area C, figure 3, on hilly topography. The major portions of the Promise silty clay profiles in this unit are of the type that display quite strongly the influence of glaciation on the materials in which they are developed.

A much smaller percentage of modal Promise silty clay, described and pictured in unit No. 22, figure 23, also occurs in this unit. Many stones are scattered throughout the profile and glacial boulders stud the surface of most of the area covered by this unit.

These soils have fair to poor tilth and a rather slow water intake rate due to the character of the parent materials from which they have developed. They are not usually susceptible to wind erosion but are subject to water erosion if control measures are not used.

No. 24. Promise-Hurley Association, Undulating

This unit is an association of two soils—the Promise soil and the Hurley soil. It occurs in soil area C, figure 3 on undulating topography. Promise soils are well drained, firm, clayey soils developed in glacio-residual or residual materials. Most of the Promise profiles in this unit are of the modal Promise silty clay type, described and pictured in unit No. 22, figure 23, which show the influence of glaciation only weakly.

Hurley silty clay, described and pictured in unit No. 16, figure 17, is an imperfectly drained, compact, claypan soil developed in glacio-residual or residual materials, or local alluvium from these materials. It occurs in slight swales, on flats, and in the microrelief pockets on upland slopes in this association. This association is composed of about 70 percent Promise soils and 30 percent Hurley soils.

Promise soils have fair to poor tilth and the Hurley soils have poor tilth. Both soils have rather slow water intake rates due to the character of the materials from which they have developed. These soils are not usually susceptible to wind or water erosion, although slight water erosion may occur on the Promise soils if control measures are not taken.

No. 25. Promise-Hurley Association, Hilly

This unit is an association of two soils—the Promise soil and the Hurley soil. It occurs in soil area C, figure 3, on hilly topography. Promise soils are well drained, firm, clayey soils developed in glacio-residual or residual materials. Most of the Promise profiles in this unit are of the modal Promise silty clay type, described and pictured in unit No. 22, figure 23, which show the influence of glaciation only weakly.

Hurley silty clay, described and pictured in unit No. 16, figure 17, is an imperfectly drained, compact, claypan soil developed in glacio-residual or residual materials, or local alluvium from these materials. It occurs in slight swales, on flats, and in the microrelief pockets on upland slopes in this association. This association is composed of about 80 percent Promise soils and 20 percent Hurley soils.

Promise soils have fair to poor tilth and Hurley soils have poor tilth. Both soils have rather slow water intake rates due to the character of the materials from which they have developed. The Hurley and Promise soils are not usually susceptible to wind erosion. Promise soils are subject to water erosion if control measures are not used.

No. 26. Promise-Pierre Association, Hilly

This unit is an association of two soils—the Promise soil and the Pierre soil. It occurs in soil areas B and C, figure 3, on hilly topography. Promise soils are well drained, firm, clayey soils developed in glacio-residual or residual materials. Most of the Promise profiles in this unit are of the modal Promise silty clay type, described and pictured in unit No. 22, figure 23, which show the influence of glaciation only weakly. In this association they occur in a patchy pattern on the smoother crests and upper slopes of the hilly topography.

Pierre soils, as described and pictured in unit No. 21, figure 22, are well drained, firm, clay soils developed in heavy shales. In this association they usually occur on the rougher, lower slopes of the hilly landscape. This association is composed of about 60 percent Promise soils and 40 percent Pierre soils.

These soils have fair to poor tilth and rather slow water intake rates due to the character of the parent materials. They are usually not susceptible to wind erosion but are subject to water erosion if control measures are not used.

No. 27. Raber-Agar, Shallow Over Till, Association, Undulating

This unit is an association of two soils—the Raber soil and the Agar soil. It occurs in the eastern part of soil area D, figure 3, on undulating topography. The Raber soils, described and pictured in unit No. 6, figure 9, are well drained, firm, clay loam soils developed in glacial till. In this association they occur on the crests and upper slopes on the undulating relief. Stones are scattered throughout the profile of this soil.

Agar soils are well drained, friable, silt loam soils developed in deep and moderately deep loess. In this association they usually occur on the lower slopes and in the upland drainageways. Most of the Agar soils in this association are of the Agar silt loam, shallow over till type, described and pictured in unit No. 7, figure 10. A few isolated stones or gravels may occur in this soil. This association is composed of about 80 percent Raber soils and 20 percent Agar soils.

The soils in this association have good tilth and water holding capacity. They are not usually susceptible to wind erosion, but they are subject to water erosion on this topography if control measures are not used.

No. 28. Raber-Agar, Shallow Over Till, Association, Hilly

This unit is an association of two soils—the Raber soil and the Agar soil. It occurs in the eastern parts of soil area D, figure 3, on hilly topography. The Raber soils, described and pictured in unit No. 6, figure 9, are well drained, firm, clay loam soils developed in glacial till. In this association they occur on the crests and upper slopes of the hilly relief. Stones are scattered throughout the profile of this soil.

Agar soils are well drained, friable, silt loam soils developed in deep and moderately deep loess. In this association they usually occur in the lower slopes and in the upland drainageways. Most of the Agar soils in this association are of the Agar silt loam, shallow over till type, described and pictured in unit No. 7, figure 10. A few isolated stones or gravels may occur in this soil. This association is composed of about 80 percent Raber soils and 20 percent Agar soils.

Soils in this association have good tilth and water holding capacity. They are not usually susceptible to wind erosion, but they are subject to water erosion on this topography if control measures are not used.

No. 29. Raber-Agar-Estevan Association, Hilly

This unit is an association of three soils—the Raber soil, the Agar soil, and the Estevan soil. It occurs in the eastern part of soil area D, figure 3, on hilly topography. Raber soils, as described and pictured in unit No. 6, figure 9, are well drained, firm, clay loam soils developed in glacial till. In this association they occur on the areas of the loess-free portions of the macroslopes not occupied by the micro-relief dips in which the Estevan soils occur.

Estevan soils, as described and pictured in unit No. 13, figure 14, are imperfectly drained, compact, claypan soils developed in glacial till. In this association they occur on the flats and in microrelief pockets on the macroslopes of the loess free portions of the undulating topography. Agar soils are well drained, friable, silt loam soils developed in deep and moderately deep loess. In this association they occur in a rather patchy pattern over the landscape with no definite positional occurrence.

The Agar, silt loam, shallow over till, described and pictured in unit No. 7, figure 10, comprises practically all of the Agar soils in this association. This association is composed of about 70 percent Raber soils, 15 percent Agar soils, and 15 percent Estevan soils.

The Agar and Raber soils in this association have good tilth and water holding capacity. Estevan soils have poor tilth and a rather slow water intake rate due to restricted drainage. The soils in this association are not usually susceptible to wind erosion. Estevan soils are not usually subject to water erosion, but the Agar and Raber soils in this association are subject to moderate water erosion if control measures are not used.

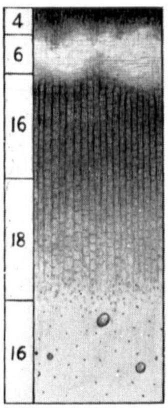
No. 30. Tetonka-Hoven Association

This unit is an association of two soils—the Tetonka soil and the Hoven soil. It occurs in rather large depressions scattered over the landscape of soil area D, figure 3. The Tetonka silty clay loam soils are imperfectly drained, compact, claypan soils developed in local alluvium from glacial drift. In this association they occur in the lower portions of large, rather marshy depressions.

Hoven silty clay loam soils, described and pictured in unit No. 14, figure 15, are imperfectly drained, compact, claypan soils developed in local alluvium. In this association they occur on the slightly higher portions of the large, rather marshy depressions. This association is composed of about 70 percent Tetonka soils and 30 percent Hoven soils.

Soils in this association have poor tilth and restricted drainage. They are not usually susceptible to wind or water erosion.

Figure 24. Tetonka Silt Loam



A_1 0-4″ Black, friable silt loam of weak, fine platy structure.

A_2 4-10″ Gray (dry), friable silt loam of strong, medium and fine platy structure.

B_2 10-26″ Black, firm clay loam of strong, medium blocky structure.

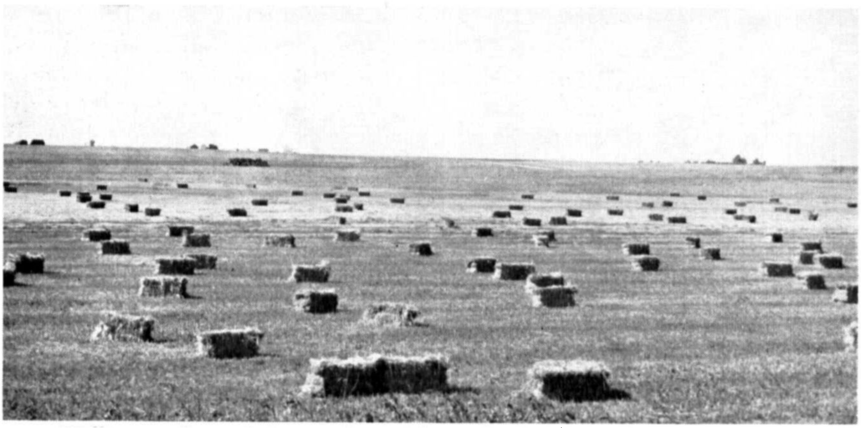
C_{ca} 26-44″ Dark grayish-brown, calcareous clay loam.

C 44-60″ Olive gray, calcareous, clay loam glacial till.

No. 31. Williams Association, Gently Undulating

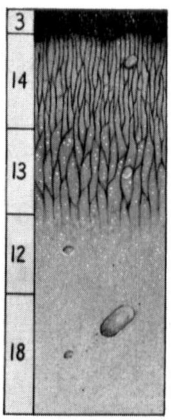
This is an association of well drained, friable to firm, loam and clay loam soils developed in glacial till. It occurs in soil area G, figure 3, on gently undulating topography. The majority of the Williams soils in this unit are modal Williams loam type, described and pictured below, and occur on the crests and upper slopes of the gently undulating relief. However, a rather large percentage of the Williams soils in this unit occur on the footslopes and in upland drainageways and have a thicker solum and probably a slightly less well drained profile than the modal Williams. Stones and gravels are scattered throughout the profiles of these soils.

These soils have good tilth and good water holding capacity and are not usually susceptible to wind or water erosion on the gently undulating topography of this unit.



Williams soil association gently undulating landscape. Light area in middle background is a depression in which the Tetonka soil occurs.

Figure 25. Williams Loam



A_1 0-3" Black, very friable loam of weak, fine granular structure.

B_2 3-17" Dark brown, friable to firm clay loam of strong, fine prismatic-blocky structure.

B_{3ca} 17-30" Dark grayish-brown, friable to firm, strongly calcareous loam of moderate, coarse and medium prismatic-blocky structure.

C_{ca} 30-42" Dark brown, friable to firm, strongly calcareous clay loam.

C 42-60" Dark yellowish-brown, friable to firm, calcareous clay loam.

No. 32. Williams Association, Undulating

This is an association of well drained, friable to firm, loam and clay loam soils developed in glacial till. It occurs in soil area G, figure 3, on undulating topography. The majority of the Williams soil in this unit are of the modal Williams loam type, described and pictured in unit No. 31, figure 25, and occur on the crests and upper slopes of the undulating topography. However, a rather large percentage of the Williams soils in this unit occurring on the footslopes and in the upland drainageways have a thicker solum and probably have a slightly less well drained profile than the modal Williams. Stones and gravels are scattered through the profiles of these soils.

These soils have good tilth and good water holding capacity and are not usually susceptible to wind erosion. They are, however, susceptible to water erosion on the undulating topography of this unit if control measures are not used.

No. 33. Williams-Crandon Association, Hilly

This unit is an association of two soils—the Williams soil and the Crandon soil. It occurs in soil areas F and G, figure 3, on hilly topography. The Williams soils are well drained, friable to firm, loam and clay loam soils developed in glacial till. Most of the Williams profiles in this unit are of the modal Williams loam type, described and pictured in unit No. 31, figure 25, and occur on the smoother slopes of the hilly topography.

Crandon sandy loam soils, described and pictured in unit No. 12, figure 13, are excessively drained, shallow, loose, sandy and gravelly soils developed from morainic outwash. In this association they occur on the sharp rises, knolls, and steeper slopes of the hilly topography. This association is composed of about 50 percent Williams soils and 50 percent Crandon soils.

Williams soils have good tilth and good water holding capacity in contrast to the Crandon soils which have poor tilth and poor water holding capacity. Williams soils are not usually susceptible to wind erosion; however, they are subject to rather severe water erosion on hilly topography if control measures are not used. Crandon soils are susceptible to some surface blowing, but water causes little erosion due to the coarseness of the materials.

No. 34. Williams-Zahl Association, Hilly

This unit is an association of two soils—the Williams soil and the Zahl soil. It occurs in soil areas F and G, figure 3, on hilly topography. Williams soils are well drained, friable to firm, loam and clay loam soils developed in glacial till. Most of the Williams profiles in this unit are of the modal Williams loam type, described and pictured in unit No. 31, figure 25, and occur on the smoother slopes of the hilly topography.

Zahl loam soils, described and pictured in unit No. 8, figure 11, are excessively drained, very shallow, friable, loam soils developed in glacial till. In this association they occur on the steep slopes of the hilly topography. This association is composed of about 80 percent Williams soils and 20 percent Zahl soils.

Williams soils have good tilth and good water holding capacity in contrast to the Zahl soils which have only fair tilth and a low water intake rate due to the steepness of the slopes on which they occur. These soils are not usually susceptible to wind erosion, but they are subject to rather severe water erosion on the hilly topography of this unit if control measures are not used.

No. 35. Alluvial Land

This unit is a land type and occurs in soil area A, figure 3. It includes undifferentiated soils developed from alluvial materials as well as raw riverwash. This unit occurs along the major drainages in the county and rather large areas of it occur along the Missouri River.

Genesis, Morphology, and Classification of Soils

Material presented in the next several pages is intended primarily for those who desire a technical discussion of the nature and origin of Potter County Soils.

The Soil Forming Factors. In Potter County, as in all other areas, the kind of soil which develops is due to the interaction of five factors—climate, living organisms (chiefly vegetation), parent material, relief, and time.

Climate and vegetation are considered the active factors of soil genesis and alter the parent material in various ways. Parent material, relief, and time condition the influences of climate and vegetation. A summary of climatic, vegetative, parent material, relief, and age characteristics of Potter County follows. Any combination of these factors may occur.

Potter County Soil Forming Factors

Climate: Chiefly dry subhumid to semiarid
Vegetation: Short, mid, and some tall grasses
Parent Materials: Loess, glacial till, shale, outwash, and alluvium
Relief: Hilly, rolling, undulating, sloping, level, and depressional
Age: Cretaceous (exposed since the Pleistocene), Pleistocene to recent

Soil Formation on Well Drained Sites. The full expression of climate and vegetation on soil formation occurs only on well drained sites, which are usually undulating or sloping areas. Soils in depressions, due to impeded drainage are subject to reducing conditions and to accumulation of the products of weathering and soil formation. Likewise soils on steep slopes are excessively drained and have such high rates of runoff and erosion that very little organic accumulation, weathering, and translocation of materials takes places in the profile.

Soils developed on well drained sites in Potter County are classified as Chestnut soils. They are formed under conditions where potential transpiration exceeds rainfall, so that water rarely leaches soluble salts out of the profile. The effect of the relative shortage of water is to give a grass vegetation with a rather short root system and hence a smaller annual production of organic matter. Thus the depth to which the organic matter reaches and its content at each depth is less than is the case in the Chernozem soils farther east. In addition, the horizon of deposition of calcium carbonate is usually closer to the surface than is the case of Chernozem soils.

The characteristics cited are best expressed in Potter County in the glacial till-derived soil, Williams. This soil occurs on undulating terrain. The soil described was taken on a 2 percent west-facing slope, 50 feet down from the crest of a slightly convex area. The till is of Mankato age.[3]

Williams Loam (Chestnut)

(Described by G. J. Buntley)

A_1 0-3″ Very dark gray to very dark grayish-brown dry, black to very dark brown moist (10YR 3/1.5 to 2/1.5 moist), noncalcareous loam; soft, weakly developed, very fine granular structure. This changes abruptly and smoothly to

B_{21} 3-13″ Very dark grayish-brown to dark grayish-brown dry, very dark brown to very dark grayish-brown moist (10YR 3.5/2 to 2.5/2 moist), noncalcareous clay loam; slightly hard, strongly developed, fine prismatic breaking to strongly developed, fine blocky structure. Structural units show thin, discontinuous clay skin development. This grades smoothly into

B_{22} 13-17″ Grayish-brown to light olive brown dry, dark grayish-brown to olive brown moist (2.5Y 5/3 to 4/3 moist), noncalcareous clay loam; slightly hard, strongly developed, medium breaking to fine prismatic in turn breaking to strongly developed fine and medium blocky structure. Structural units show somewhat thicker, continuous clay skin development. This changes clearly and smoothly to

B_{3ca} 17-30″ Light brownish-gray dry, dark grayish-brown moist (2.5Y 6/2 to 4/2 moist), strongly calcareous clay loam with large amounts of segregated lime (2.5Y 8/0); slightly hard, moderately developed, coarse breaking to medium prismatic in turn breaking to moderately developed, medium and coarse blocky structure. Structural units show thin, continuous grading downward to discontinuous clay skin development. This grades irregularly into

C_{ca} 30-42″ Light brownish-gray to light yellowish-brown dry, dark grayish-brown to olive brown moist (2.5Y 6/3 to 4/3 moist); friable strongly calcareous horizontal blocky, clay loam glacial till with large amounts of segregated lime (2.5Y 8/0). Salt crystals common.

C 42-60″ Pale yellow dry to olive brown moist (2.5Y 7/4 to 4/4 moist); friable, strongly calcareous, massive, clay loam glacial till.

The soils developed from heavy clay loam till, loess, and clay on well drained sites differ somewhat from the Williams soil described.

The soils developed from heavy clay loam till are in the Raber series. They are distinguished from the Williams soils by their much more strongly developed B horizon, and the presence of large, soft, white calcium carbonate segregations in their B_{3ca} and C_{ca} horizons. The parent till of the Raber series in this county apparently is of an older age than is the till underlying the Williams soils.

Soils developed in loess on well drained positions are in the Agar series. They occur on nearly level to sloping terrain and have slightly darker and deeper profiles than the Williams soils due, undoubtedly, to the fact that the parent loess of the Agar is more permeable than is the parent till of the Williams. A profile description of Agar follows.

[3]Flint, R. F., "1954 Pleistocene Geology of Eastern Sothu Dakota," USGS Prof. Paper No. 262.

Agar Silt Loam

(Described by C. A. Mogen)

A_1 0-5" Very dark-gray (10YR 3/1, dry), very dark brown (10YR 2/2 moist) soft silt loam; moderately developed fine crumb structure; very friable when moist. Gradual boundary. 4 to 11 inches thick.

B_1 5-10" Dark grayish-brown (10YR 4/2, dry) to between very dark brown and very dark grayish-brown (10YR 2.5/2, moist) silt loam with a moderately developed medium prismatic structure. Soft, dry; friable, moist. Gradual boundary 3 to 6 inches.

B_2 10-20" Light olive brown (2.5Y 5/3, dry) to olive brown (2.5Y 4/3, moist) silt loam having a compound structure of well-defined, medium, and fine prisms breaking into moderate medium and fine subangular blocks; slightly hard when dry, friable when moist. Clear boundary. 4 to 15 inches thick.

B_{3ca} 20-30" Light brownish-gray (2.5Y 6/2, dry) to dark grayish-brown (2.5Y 4/2, moist) calcareous silt loam having a moderately developed coarse structure; slight amount of segregated lime in white threads and small concretions; hard when dry; friable when moist. Gradual boundry. 5 to 10 inches thick.

C_{ca} 30-42" Light brownish-gray (2.5Y 6/2, dry) to grayish-brown (2.5Y 5/2), moist) calcareous silt loam having coarse prisms when dry; slight amount of segregated lime in white threads and small soft concretions; hard when dry, friable when moist. Gradual boundry. 10 to 12 inches thick.

C 42-60" Light brownish-gray (2.5Y 6/2, dry) to grayish-brown (2.5Y 5/2, moist) calcareous silt loam having a weak coarse prismatic structure; hard when dry, friable when moist.

Several variants or phases of Agar occur in this area. On convex and plane slopes the soil described above is dominant. On level and slightly concave areas the solum thickens, due partly to additions of local alluvium. Soils on the narrow rounded tops of tabular divides have thinner sola and thinner, lighter colored A_1 horizons.

The Akaska series is developed in a mantle of loess, 24 to 60 inches thick, over outwash sand and gravel. These soils resemble the Agar in solum characteristics.

The Oahe series is developed in a loam alluvium over outwash sands and gravels. They have the solum morphology of Chestnut soils but have a porous substratum. The horizon of calcium carbonate accumulation is well developed and occurs over the porous sands and gravels.

Soils developed from clay on well drained sites are classified into the Promise and Pierre series. Promise soils are developed in clay, 20 to 60 inches thick, overlying Pierre shale. The origin of the clay is in places glacio-residual, eolian, or residual from more easily weathered members of the Pierre formation. Promise soils occur on slopes ranging from nearly level to hilly. A profile description of Promise clay follows.

Promise Clay

(Described by C. A. Mogen)

A_1 0-5" Dark gray (2.5Y 4/1, dry) very dark gray (2.5Y 2.5/1, moist) clay having a compound structure of hard moderate medium sized prisms and subangular blocks separating to very fine angular blocks; friable when moist. The upper 1½ inches has a strong very fine granular structure. Gradual boundry.

B_2 5-19" Olive gray (5Y 5/2, dry) grading downward to light olive gray (5Y 6/2, dry) dark grayish-brown (2.5Y 4/2, moist) weakly calcareous clay having a compound structure of moderate coarse prisms separating weakly to medium sized prisms and very fine blocks; extremely hard when dry; very firm when moist. Gradual boundary.

B_{3ca} 19-29" Light olive gray (5Y 4/2, dry) very dark grayish-brown (2.5Y 3/2, moist) clay having a compound structure of moderate coarse and medium sized blocks separating weakly to very fine blocks; extremely hard when dry; very firm when moist; weakly calcareous with a very slight amount of segregated lime in small soft concretions. Thin tongues of the A_1 horizon extend through to the base of this horizon.

C_{sa} 29-46" Olive gray (5Y 5/2, dry) mottled very dark grayish-brown and dark grayish-brown (2.5Y 3/2 and 4/2, moist) massive clay; extremely hard when dry; very firm when moist; many small nests of salt crystals; moderately calcareous without segregated lime. Clear irregular boundary.

C 46-60" Between olive gray and olive (5Y 5/2.5, dry) black (2.5Y 2.5/2, moist) clay banded thinly with dark grayish-brown (2.5Y 4/2, moist) silty clay loam; massive; hard when dry; firm when moist; moderately calcareous without visible lime.

Soils of the Pierre series resemble those of the Promise series in general morphology except that their profiles are shallower to bedded shales—usually less than 20 inches.

Soil Formation on Hilly Sites. On steep or hilly areas the influence of slope overrides the influence of climate and vegetation. Runoff is high, percolation is low, and plant growth is restricted, therefore organic accumulation is slight and a thin, relatively unweatherad, usually eroded, soil results. These soils are classified as Regosols if developed in unconsolidated material, and Lithosols if developed in consolidated rock.

The Regosols in Potter County include the following hilly soils—the Crandon, developed in coarse morainic outwash, the Zahl derived from loam glacial till, and the Joe Creek developed in recent calcareous loess. The only Lithosol mapped in this survey was the Lismas which is developed in Pierre shale on steep slopes. The Zahl soil, an example of a Regosol is described.

Zahl Loam (Regosol)

(Described by G. J. Buntley)

A_1 0-4" Dark gray dry to very dark gray moist (10YR 4/1.5 to 3/1.5 moist), slightly calcareous loam; soft, weakly developed, fine granular structure. This changes abruptly and smoothly to

C_{ca11} 4-27" Light gray dry and light brownish-gray to light olive brown moist (2.5Y 7/2 to 6/3 moist), strongly calcareous clay loam with much segregated lime (2.5Y 8/0); soft, massive glacial till. This grades irregularly into

C_{ca12} 27-33" Light gray to pale yellow dry and olive moist (2.5Y 7/3 to 5Y 5.5/3 moist), moderately calcareous clay loam with a moderate amount of segregated lime (2.5Y 8/0); soft, massive glacial till. This grades irregularly to

C_2 33" Light gray to pale yellow dry and olive moist (2.5Y 7/3 to 5Y 5/3 moist) moderately calcareous clay loam; slightly hard, massive glacial till.

Soil Formation on Poorly Drained Sites. In depressional positions or on flats having no surface drainage and slow internal drainage, several groups of poorly drained soils are recognized. The development of these soils is conditioned by the relief factor, in this case a depressional position which causes ponding, and the active factors of soil formation—climate and vegetation—do not dominate soil formation as they do in Chestnut soils. Among the groups of poorly drained soils recognized in Potter County are the Solonchak, Solonetz, and Solod.

Solonchak literally means "much salt" and so this group of soils are saline to the point where the growth of most crop plants is retarded.[4] These soils are found on low-lying, poorly drained flats where salt-bearing ground water occurs at or near the surface. When dry, these soils have a white crust or efflorescence which is dissolved each time the soil becomes wet. The Solonchak soils in Potter County are classified in the Sage series. They occur principally on large flats between the towns of Lebanon and Hoven. The Sage soils show poor horizon differentiation.

Solonetz literally means "little salt." These soils form after salts have been removed, but the base exchange of the soil still contains over 15 percent or more of exchangeable sodium. Under wetting and drying conditions this sodium saturated clay becomes dispersed and a dense black B horizon of columnar structure developes which is hard when dry and plastic when wet. This is the Solonetz profile. The dispersed clay in the B horizon undergoes hydrolysis after the sodium has been removed starting at the top of the horizon, and a residue of white colloidal silica forms. After this white or gray, platy, A_2 horizon forms the profile is called a solodized Solonetz.

Four Potter County soils are classified in the Solonetz group. The Hoven soils are Solonetz soils which developed in shallow, flat-bottomed depressions and sloughs. The Estevan soils are till-derived and occur on flats and in small depressions in association with the Williams soils.

The Hurley soils are developed in clay in close association with the Promise and Pierre soils, and the Northville are solodized Solonetz soils developed in alluvium. A description of the Estevan silt loam which is representative of the Solonetz group follows.

Estevan Silt Loam (solodized-Solonetz)

(Described by G. J. Buntley)

A_1 0-2½" Dark brown dry to black moist (10YR 4/3 to 2/1 moist), noncalcareous silt loam; soft, weakly developed, fine and very fine granular structure. This changes clearly and smoothly to

A_2 2½-6" Grayish-brown dry to very dark brown moist (10YR 5/2 to 2/2 moist) noncalcareous silty clay loam; soft, moderately developed, medium and

[4]Concentrations of salts over 0.15 to 0.20 are considered harmful to most crop plants. The salts present are dominantly the sulfates and chlorides of sodium, magnesium, and calcium.

coarse prismatic breaking to moderately developed, fine and medium platy structure. This changes abrutly and smoothly to

B_2 6-12" Dark grayish-brown dry to very dark grayish-brown moist (10YR 4/2 to 3.5/2 moist), noncalcareous clay loam; extremely hard, strongly developed, medium and coarse columnar breaking to strongly developed, medium and fine blocky structure. Some lime flour coatings on the outsides of the primary structural units in lower 1" or 1½" of this horizon. This changes clearly but irregularly to

B_{3ca} 12-16" Grayish-brown dry and dark grayish-brown to olive brown moist (2.5Y 5/2 to 4/3 moist), strongly calcareous clay loam with much segregated lime (2.5Y 8/2); very hard, moderately developed, medium prismatic breaking to moderately developed, medium blocky structure. This grades irregularly into

C_{ca_1} 16-20" Grayish-brown dry and grayish-brown to light olive brown moist (2.5Y 5/2 to 5/3 moist) strongly calcareous silty clay with much segregated lime, very hard, massive to weakly developed, coarse prismatic structure. This grades irregularly into

C_{ca_2} 20-26" Light brownish-gray dry and dark grayish-brown to olive brown moist (2.5Y 6/2 to 4/3 moist) slightly hard, moderately calcareous massive silty clay with a moderate amount of segregated lime and salt (2.5Y 8/2). This changes clearly but irregularly to

C_2 26-60" Olive gray dry to dark gray moist (5Y 5/2 to 4/1.5 moist), firm, moderately calcareous, massive silty clay with a slight amount of segregated lime.

Besides the Solonchak and Solonetz groups, there is a third group of poorly drained soils in Potter County. This is the Solod group and these soils are essentially solodized Solonetz soils in which the solodization process has extended through or nearly through the B horizon. The soil series representaive of this group is the Tetonka. These soils have dark platy A_1 horizons, thick, gray, platy A_2 horizons; the B horizon may be absent but if present, it has a blocky structure. The C horizon may be glacial till, alluvium, or loess.

The classification of the Potter County soil series is shown in table 5.

Table 5. Classification of the Soil Series of Potter County, South Dakota

	Parent Material — C Horizon				Lower Layer — D Horizon			Rogosols and/or			Solonetz and Solodized	
Physiography	Texture	Kind	Lithology	Depth	Texture	Kind	Lithology	Lithosols	Chestnut	Solonchak	Solonetz	Solod
Upland	sandy and gravelly loam	drift	mixed	6-10″	sand and gravel	moraine outwash	mixed	Crandon	....	....	....	....
Outwash plain	loam	alluvium	mixed	24-60″	sand and gravel	outwash	mixed	....	Oahe	....	....	....
Outwash plain	silt loam	loess	mixed	24-60″	sand and gravel	outwash	mixed	....	Akaska	....	....	....
Upland	loam	glacial till	mixed	60″+	....	....	....	Zahl	Williams	....	Estevan	Tetonka
Upland & Terrace	silt loam	recent loess	mixed	60″+	....	....	....	Joe Creek	....	....	....	....
Upland	silt loam	loess	mixed	15-60″+	loam to clay	residual or till	shaly or mixed	....	Agar	....	....	....
Terrace	silty clay loam	alluvium	mixed	60″+	....	....	....	....	....	....	Northville	....
Upland	clay loam	glacial till	mixed	60″+	....	....	....	....	Raber	....	....	....
Basin	silty clay loam to clay	alluvium	mixed	36-60″+	loam to clay	residual or till	shaly or mixed	....	....	Sage	Hoven	....
Upland	silty clay to clay	till or residuum	shaly or mixed	30-60″	bedded	residual	shale	....	Promise	....	Hurley	....
Upland	clay	residuum	shale	0-30″	bedded	residual	shale	Lismas	Pierre	....	....	....
Terrace	clay	alluvium	shale	60″+	....	....	....	....	Orman	....	....	....

DEFINITIONS OF SOME SOIL TERMS

Alkali soil—A soil that contains sufficient exchangeable sodium to interfere with the growth of most crop plants.

Alluvium—Fine material, as sand, mud, or other sediments deposited on land by streams.

Calcareous soil—Soil containing sufficient calcium carbonate to effervesce when treated with dilute hydrochloric acid.

Clay—The small mineral soil grains, less than 0.002 mm. (0.000079 inch) in diameter.

Claypan—A dense and heavy soil horizon underlying the upper part of the soil; hard when dry, sticky when wet.

Clay soil—Soil containing 40 percent or more clay, less than 40 percent, silt and less than 45 percent sand.

Glacial till—Rock and earth materials that have been transported through the action of ice (glaciers).

Lacustrine deposits—Materials deposited by lake waters.

Loam soil—Soil containing 7 to 27 percent clay, and 28 to 50 percent silt, and less than 52 percent sand.

Loess—A fine textured, usually silty deposit laid down by wind.

Permeability—Readiness with which the soil transmits water.

Profile—A vertical section of the soil through all of its horizons and extending into the parent material.

Saline soil—A soil that contains sufficient soluble salt to interfere with the growth of most crop plants.

Sand—Small rock or mineral fragments with diameters ranging from 0.05 mm. (0.002 inch) and 1.0 mm. (0.039 inch).

Sandy loam—Soil containing 40 to 85 percent sand, and less than 20 percent clay, and less than 50 percent silt.

Silt—Small mineral soil grains ranging from 0.05 mm. (0.002 inch) to 0.002 mm. (0.000079 inch) in diameter.

Silty clay—Soil containing 40 percent or more clay, and 40 percent or more silt.

Silty clay loam—Soil containing 27 to 40 percent clay and less than 20 percent sand.

Silt loam—Soil containing 50 percent or more silt, and 12 to 27 percent clay; or 50 to 80 percent silt and less than 12 percent clay.

Soil horizon—A layer of soil approximately parallel to the land surface, with relatively well-defined characteristics that have been produced through the operation of soil building processes.

Texture—The relative proportion of sand, silt, and clay.

Tilth—The physical condition of the soil in respect to its fitness for the growth of a specified plant.

Management

SOIL MANAGEMENT AND PRODUCTIVITY

SOIL MANAGEMENT problems that confront the farmers in Potter County are largely centered around the more efficient utilization of the rainfall received. This may be accomplished by growing crops with low moisture requirements and arranging them in cropping sequences that permit the most advantageous use of the soil moisture. Other practices which aid in efficient moisture utilization include control of water losses by runoff and by weed transpiration. In addition there are problems of erosion, tillage, and declining fertility. Some of the important principles that will influence soil management related to these problems are discussed in this section.

Moisture Conservation and Weed Control. Enormous amounts of water are needed by most farm crops for growth and development. For example, about 550 pounds of water are required to produce a pound of dry matter for wheat, while approximately 840 pounds of water are necessary to produce a pound of dry matter for alfalfa. Crop yields depend to a large extent upon how efficiently the rainfall is stored and used and how effectively the losses due to weeds and runoff are controlled.

The value of storing moisture through moisture conserving practices is much greater than would seem possible from the relatively small quantities of water that can be stored. The value of 1 inch of conserved water is equal to approximately 3 or 4 bushels of wheat providing the annual precipitation is sufficient to meet the minimum requirements or enough to prevent a crop failure.

Moisture conserving crops like corn or sorghum will leave a reserve of moisture for the succeeding crop. This reserve is roughly half the carry-over which results from summer fallow. A clean fallow may store about 20 to 25 percent of the precipitation, except on those soils which are too sandy to hold material quantities of water. To be effective, summer fallow tillage operations must be performed in such a manner that the weeds are destroyed but the surface is left resistant to runoff and wind erosion.

Moisture used by weeds is a serious water loss in Potter County. For each pound of dry matter produced, Russian Thistle uses about 336 pounds of water and Sunflower uses about 705 pounds of water.

One of the most effective, but least expensive, methods of controlling weeds is to plant only clean seed. Once weeds become established, cultural methods and chemical methods may be used for eradication. Cultural methods include the use of good rotations and the use of competing crops. When the soil is kept at a high level of fertility, grain crops will compete more favorably with the weeds by stooling out more, growing faster, and smothering them.

In a crop rotation such as corn-wheat-alfalfa, several opportunities occur to cut off weeds close to the ground before they ripen seed. This method of control will work on most annual weeds although wild oats may survive this treatment. A successful method currently used for control of wild oats involves a delayed seeding date with light cultivations in the fall and in the spring prior to seeding.

Noxious weeds are perennials with spreading or creeping root systems or with underground parts which are difficult to control by tillage. Cultural methods for control of these weeds include growing of competitive crops, raising an intertilled crop, or using a system of intensive cultivation. Competitive crops include alfalfa, sweet clover, winter rye, close drilled sorghum, and sudan grass. If the practice of fallowing is used, cultivation every 2 or 3 weeks is usually effective in weed control. Additional information on weed control can be obtained from the county agent or from South Dakota State College.

Maintaining Organic Matter. The importance of maintaining organic matter in the soil is easy to overlook. Organic matter acts as a sponge for absorbing moisture, as food for useful micro-organisms, and as a storehouse for plant food elements. It also improves the structure and permeability of soils which in turn permits more rainfall to soak into the ground, thereby reducing the wasteful runoff. A decrease in soil organic matter as a result of cropping and cultivation is always associated with a corresponding decrease in yield.

At present these soils are losing organic matter at an average rate of about one-half of 1 percent yearly.[5] This loss occurs because part of each crop is removed from the land, and because cultivation stimulates a more rapid decomposition of organic residues. If crop yields are to be held at a satisfactory level it is necessary to replenish and to maintain a supply of organic residues in the soil.

[5]South Dakota Agricultural Experiment Station Circular 92, *Fertility Maintenance and Management of South Dakota Soils.*

Organic matter may be added by plowing under crop residues, applying barnyard manure, and using green manure crops.

All crop residues should be returned to the soil. Burning straw is a wasteful practice from the standpoint of organic matter maintenance. The straw from a crop of wheat yielding 15 bushels to the acre contains about 15 pounds of nitrogen to the acre. Since nitrogen is a necessary constituent of organic matter, the amount of nitrogen returned is a measure of the organic matter returned (organic matter contains about 3 percent nitrogen).

Barnyard manure supplies plant food elements in addition to organic matter. A ton of manure contains approximately 10 pounds of nitrogen, 5 pounds of phosphorus, 10 pounds of potash, and small amounts of several of the trace elements.

To maintain soil organic matter on farms with limited livestock, it is necessary to use green manure crops or grasses and legumes in rotations. Legumes are the best green manure crops because they obtain a large part of their nitrogen from the air with the aid of symbiotic soil micro-organisms.

Alfalfa can return as much as 80 pounds of nitrogen to the acre when the second cutting is plowed under during the third year. Alfalfa will not add much additional nitrogen to the soil after the second or third year.

The amount of nitrogen fixed by sweet clover depends on the amount of growth it makes the first fall and following spring. A 14-inch growth plowed under can return as much as 30 pounds of nitrogen to the acre. For every ton of sweet clover plowed under, approximately 50 pounds of nitrogen are added to the soil. It takes about 35 pounds of nitrogen to produce a 15-bushel crop of wheat and 37 pounds of nitrogen a 25-bushel corn crop.

Grasses and legumes improve soil structure besides adding organic matter. Grasses are especially beneficial in this respect with their evenly distributed, fibrous root systems which tend to form a porous, well aerated soil.

Crop Rotations. In general, the yield of crops and their immediate effect upon each other are the factors of primary importance in arranging a dryland rotation. In selecting crops and assigning them to a place in a rotation, considerable attention should be given to their effect on residual soil moisture as well as to their effect on soil fertility. A discussion of the advantages and limitations of several rotations follows.

(1) *Corn-small grain-small grain.* This rotation is composed entirely of soil depleting crops and its continued use will eventually lower the the fertility level of the soil to a point where crop yields are seriously reduced.

From an immediate yield standpoint there are several advantages in favor of this rotation. Use of an inter-tilled crop such as corn or sorghum will help to control weeds. Extra cultivations stimulate the breakdown of soil organic matter and facilitate the release of more available nitrogen.

The inter-tilled crop will also leave a reserve of moisture in the soil for the next year's small grain. In Potter County the most important cash crop is wheat and with this rotation, two-thirds of the land is planted to the highest paying crop.

(2) ***Corn-small grain+sweet clover-summer fallow-small grain.*** Including sweet clover will help maintain the nitrogen and organic matter in the soil, but it may seriously deplete the reserve of moisture.

When summer fallow follows the legume, it provides the moisture necessary for soil micro-organisms at a time when soil temperatures are suitable for their activity in breaking down organic matter. In this way, fallow provides a reserve of both moisture and nitrogen for the next crop. The most valuable cash crop, wheat, would be placed in the most favorable position—immediately after the fallow.

(3) ***Continuous wheat.*** Small grain land is usually devoid of moisture at harvest time, so the following crop must depend entirely on the precipitation of that particular year. Weeds, especially wild oats, become more troublesome with each crop of small grain. The rate of nitrification is at a minimum with this system of cropping and nitrogen deficiencies often develop.

(4) ***Wheat-wheat-fallow.*** With this sequence of wheat and fallow the weeds are more easily controlled than with continuous wheat. Moisture is stored and nitrogen is made available for the first cash crop after summer fallow. The rate of fertility decline, however, would be about as fast as with the continuous wheat system.

(5) ***Corn-small grain-corn-small grain-small grain+alfalfa-alfalfa 4 to 6 years.*** This is a long time rotation that may be more acceptable to the livestock farmer. It will help to maintain the organic matter and fertility. Weeds will be more easily controlled but a smaller portion of the land will be in the high value cash crops. Increased grain yields will make up a part of this difference however. To avoid a moisture shortage after alfalfa, plow it after the first cutting and fallow the land for the rest of the year.

Tillage. One of the first principles to consider in tillage is to maintain a surface condition that encourages water penetration.

Cultivation stimulates the breakdown of soil organic matter thus releasing available nutrients, especially nitrogen.

Another important principle of cultivation involves the destruction of competing weed growth. Implements should be used that thoroughly destroy weeds, yet leave the surface in a condition to absorb water while resisting erosion. Stubble mulch tillage is a practice that usually fulfills these requirements.

The optimum amount of tillage is also an important consideration. The tillage operations should be limited to the minimum number that will accomplish the desired purposes. Too much cultivation breaks down the cloddy structure of the soil, leaves a surface that favors runoff and wind erosion, and increases cost.

Plant Nutrients and the Use of Commercial Fertilizer. Plant nutrient deficiencies vary with the kind of soil and the management the plant receives. The steeply sloping eroded soils are more deficient than those non-eroded soils with thick dark A horizons on nearly level topography. Soils which have been heavily cropped to small grains and corn without the return of barnyard manure, crop residues, or green manure, usually are low in nitrogen.

Responses to phosphorus are usually confined to the eroded soils or to bottom land alluvial soils with free lime at the surface. Free lime ties up a considerable amount of phosphorus in a chemical form that is unavailable to most plants.

With sufficient rainfall, corn will respond to nitrogen fertilizers. The climate in Potter County, however, quite often sets a ceiling on corn yield which is lower than that imposed by a lack of fertility.

Small grains are more promising for the successful use of commercial fertilizer. Nitrogen is the most limiting element, but yield increase will not be obtained by applications of commercial nitrogen if the crop requirements have been met by the use of legumes, manure, or summer fallow.

Grasses are very responsive to nitrogen applications both for seed and for forage production.

A soil testing service is maintained at the Agronomy Department at South Dakota State College. Samples of soil can be sent to this laboratory to be analyzed to determine their available nutrient supply. Additional information on soil testing and also on the use of commercial fertilizers can be obtained from the county agent and from South Dakota State College.

Practices for Control of Wind Erosion. Principles involving the control of wind erosion are: (1) reducing wind velocity, (2) trapping the moving soil, and (3) using a vegetative cover.

Wind velocity can be reduced by planting shelterbelts, but it takes several years for the trees to grow high enough to become effective. The area affected by the shelterbelt is limited to about five times its height on the windward side and 20 to 30 times its height on the leeward side.

Practices used to trap moving soil include planting alternate strips of grasses or legumes with strips of corn or wheat. Deep listing is another way to trap moving soil particles. Lister furrows may be an effective control measure if the listing is done in time. Any implement that leaves the soil in a rough or cloddy condition or in rough ridges can be used for emergency tillage.

Maintaining a vegetative cover is one of the most important ways of reducing wind erosion. Crop residues should be left on the surface instead of plowed under. A small grain stubble plus the straw from the combine will greatly reduce the velocity of the wind at ground level and decrease the amount of erosion.

Practices for Control of Water Erosion. On the longer slopes, water erosion may be controlled by use of terraces, contour cultivation, contour strip cropping, and the seeding down of waterways.

Shorter slopes are not well suited for contour farming and control may be accomplished by keeping the land planted to grass and legumes a greater proportion of the time. These crops provide a protective cover and also add organic matter. The organic matter improves the soil structure, which permits a more rapid rate of water infiltration. This reduces the amount of runoff and soil loss. Soil high in organic matter will also have a higher proportion of water stable aggregates which resist the destructive effect of rapidly moving water.

Principal Management Practices for Individual Potter County Soils

Yields of some soils are often limited because of special problems or limitations that are specific for that particular soil. Occasionally a limitation takes on a broader aspect and is common for most of the soils in an area. An example of one of the more inclusive problems is the maintenance of nitrogen and organic matter. Table 6 lists some of the principle management practices that will help to cope with the inherent problems of Potter County soils and in this way will help maintain or increase yields.

The first practice listed in table 6 is growing legumes to increase subsoil permeability. This is especially important for the claypan soils. The maintenance of nitrogen and organic matter by growing legumes pertains to most of the soils in the county.

For soils that are more easily eroded by wind, as much of the crop residue as possible should be left on the surface. For those soils not so easily eroded, more residues can be safely plowed under. A crop rotation with a small grain crop, an inter-tilled crop, and a legume crop followed by summer fallow will help to maintain fertility, control weeds, and conserve moisture. It is fairly well adapted to most of the soils in the area. Soils which occur on the more level areas have thicker, darker A horizons and high yields are more easily maintained. For these soils commercial nitrogen and manure with legumes grown only occasionally will be sufficient for fertility maintenance. Those soils that require special practices for control of wind and water erosion are listed under the appropriate headings. Grass cover is suggested for areas poorly suited for cultivation.

Productivity of Potter County Soils

Estimated yields for corn, wheat, and oats are presented in table 7. These yields are for three growing conditions and three systems of management.

Three growing conditions—unfavorable, favorable, and very favorable—were arbitrarily selected to facilitate a condensed presentation of data. The growing conditions in any one year may not fall precisely in any one of the above categories but may be on the border between two of them. In border years the crop yields will be affected accordingly.

A favorable year was considered to be one with no serious limitations regarding amount of rainfall, or its distribution, adverse temperature, or any other limiting growing condition. While there are no serious limitations in a favorable year, the growing conditions are not ideal for a bumper crop.

Very favorable conditions represent the most desirable conditions for plant growth that occur in Potter County. These will occur not more than 20 to 25 percent of the time. Unfavorable conditions are characterized by a serious limitation in lack of rainfall, adverse temperature, or other growing conditions that will severely restrict yield.

Yield estimates are given for only three systems of management. The primary purpose of this table is to indicate the yield increases obtainable from the application of 20 pounds of nitrogen and use of sweet clover fallow compared to a straight corn and small grain rotation.

In management system B, the nitrogen is purchased instead of taken from the atmosphere through the use of legumes. For the present, a lack of nitrogen is the most serious and widespread plant food deficiency problem in Potter County. With favorable moisture and continued

Table 6. Principal Management Practices For Individual Potter County Soils

Practice	Number of Soils for Which Practice Applies*
Maintaining Organic Matter	
Increase subsoil permability by growing legumes	13, 14, 15, 16, 18
Maintaining nitrogen and organic matter by growing legumes	All soils
Residue Management	
Leave most of crop residues on surface for wind erosion control	19
Leave part of crop residues on surface for wind erosion control	All soils except 19
Rotations	
Crop rotation with small grain intertilled crop and legume followed by summer fallow	3, 4, 5†, 6, 10, 11, 17†, 18, 19, 22, 24, 27, 32, 35#
Crop rotation with small grain and intertilled crop with nitrogen obtained from commercial fertilizer, manure, and occassional legumes	1, 2, 9, 31
Erosion Control	
Control water erosion with appropriate practice‡	3, 4, 5, 8, 11, 12, 17, 19, 21, 22, 23, 24, 25, 26, 27, 28, 29, 32, 33, 34
Control of wind erosion with special special practices§	19
Pasture Management	
Use a grazing system to maintain desirable vegetation	5‖, 7, 8, 12, 13, 14, 15, 16, 17‖, 20, 21, 23, 25, 26, 28, 29, 30, 33, 34, 35#

*Practices other than those shown may apply but the practices checked are especially applicable for the soil considered.
†For Agar or Joe Creek part of association.
‡For practices of water erosion control see section on water erosion, page 51.
§For practices of wind erosion control see section on wind erosion, page 51.
‖For Lismas part of association.
#These soils are arable where in large blocks and well drained.

Table 7. Estimated Yields of Corn, Wheat, and Oats Under Three Growing Conditions and Three Systems of Soil Management

		Management Practices		Growing Conditions and Yields in Bushels Per Acre†								
	System of			Unfavorable			Favorable			Very Favorable		
Soil No.*	Management†	Rotation‡	Fertilizers Per Acre	Corn	Wheat	Oats	Corn	Wheat	Oats	Corn	Wheat	Oats
	A	C Sg Sg	None	10-12	7-9	15-18	20-22	15-17	30-32	28-30	20-22	40-42
1	B	C Sg Sg	20# N. on each Sg	11-13	9-12	22-25	22-24	20-22	40-43	30-32	27-29	55-58
	C	C Sg + S. Clover Summer fallow Sg	None	11-14	10-13	25-28	22-25	21-24	48-51	30-33	29-32	65-68
	A	C Sg Sg	None	9-11	6-8	13-16	19-21	13-15	28-30	27-29	18-20	38-40
2	B	C Sg Sg	20# N. on each Sg	10-12	8-11	20-23	21-23	18-20	38-41	29-31	26-28	53-56
	C	C Sg + S. Clover Summer fallow Sg	None	10-13	9-12	23-26	21-24	19-22	56-59	29-32	28-31	62-65
	A	C Sg Sg	None	8-11	5-7	9-12	15-17	10-12	24-26	22-24	15-17	34-36
3	B	C Sg Sg	20# N. on each Sg	9-12	7-10	16-19	17-19	14-16	34-37	24-26	23-25	49-52
	C	C Sg + S. Clover Summer fallow Sg	None	9-13	8-11	19-22	17-20	15-18	52-55	24-27	25-28	58-61
	A	C Sg Sg	None	6-9	2-5	4-9	11-13	6-8	16-18	17-19	11-13	23-25
4	B	C Sg Sg	20# N. on each Sg	7-10	3-7	10-13	13-15	10-12	24-27	19-21	18-20	36-39
	C	C Sg + S. Clover Summer fallow Sg	None	7-11	4-8	13-16	13-16	11-14	40-43	19-22	19-22	46-49
	A	C Sg Sg	None	4-6	2-5	4-9	11-13	7-9	17-19	17-19	12-14	24-26
5§	B	C Sg Sg	20# N. on each Sg	6-8	3-7	10-13	13-15	11-13	25-28	19-21	20-22	37-40
	C	C Sg + S. Clover Summer fallow Sg	None	0-11	4-8	13-16	13-16	12-15	42-45	19-22	21-24	47-50
	A	C Sg Sg	None	7-10	4-6	8-11	13-15	9-11	20-22	20-22	14-16	30-32
6	B	C Sg Sg	20# N. on each Sg	8-11	6-9	15-18	15-17	13-15	30-33	22-24	22-24	44-47
	C	C Sg + S. Clover Summer fallow Sg	None	8-12	7-10	18-21	15-18	14-17	48-51	22-25	23-26	54-57
	A	C Sg Sg	None	7-10	4-6	9-12	13-15	9-11	22-24	20-22	14-16	32-34
9	B	C Sg Sg	20# N. on each Sg	8-11	6-9	16-19	15-17	13-15	32-35	22-24	22-24	46-49
	C	C Sg + S. Clover Summer fallow Sg	None	8-12	7-10	19-22	15-18	14-17	50-53	22-25	23-26	56-59
	A	C Sg Sg	None	6-9	2-5	8-11	12-14	8-10	19-21	19-21	13-15	28-30
10	B	C Sg Sg	20# N. on each Sg	7-10	3-7	15-18	14-16	12-14	28-31	21-23	21-23	42-45
	C	C Sg + S. Clover Summer fallow Sg	None	7-11	4-8	18-21	14-17	13-16	45-48	21-24	22-25	51-54
	A	C Sg Sg	None	6-9	2-5	6-10	11-13	7-9	18-20	17-19	12-14	26-28
11	B	C Sg Sg	20# N. on each Sg	7-10	3-7	12-15	13-15	11-13	26-29	19-21	20-22	40-43
	C	C Sg + S. Clover Summer fallow Sg	None	7-11	4-8	16-19	13-16	12-15	43-46	19-22	21-24	49-52
	A	C Sg Sg	None	0-6	2-5	0-7	9-11	4-6	14-16	15-17	9-11	21-23
13	B	C Sg Sg	20# N. on each Sg	0-8	3-7	6-12	11-13	8-10	22-25	17-19	16-18	34-37
	C	C Sg + S. Clover Summer fallow Sg	None	0-9	4-8	10-15	11-14	9-12	38-41	17-20	17-20	44-47

Table 7. Estimated Yields of Corn, Wheat, and Oats Under Three Growing Conditions and Three Systems of Soil Management (Continued)

16	A	C Sg Sg	None	**	0-5	0-7	....	4-6	13-15	....	9-11	19-21
	B	C Sg Sg	20# N. on each Sg	....	0-7	6-12	....	8-10	21-24	....	16-18	32-35
	C	C Sg + S. Clover	None	....	4-8	10-15	....	9-12	37-40	....	17-20	42-45
		Summer fallow Sg										
17§	A	C Sg Sg	None	4-6	2-5	4-9	11-13	7-9	17-19	17-19	12-14	24-26
	B	C Sg Sg	20# N. on each Sg	6-8	3-7	10-13	13-15	11-13	25-28	19-21	20-22	37-40
	C	C Sg + S. Clover	None	0-11	4-8	13-16	13-16	12-15	42-45	19-22	21-24	47-50
		Summer fallow Sg										
18	A	C Sg Sg	None	6-9	4-6	9-12	12-14	9-11	21-23	19-21	14-16	31-33
	B	C Sg Sg	20# N. on each Sg	7-10	6-9	16-19	14-16	13-15	31-34	21-23	22-24	45-48
	C	C Sg + S. Clover	None	7-11	7-10	19-22	14-17	14-17	49-52	21-24	23-26	55-58
		Summer fallow Sg										
19	A	C Sg Sg	None	4-6	2-5	4-9	10-12	6-8	17-19	16-18	11-13	24-26
	B	C Sg Sg	20# N. on each Sg	6-8	3-7	10-13	12-14	10-12	25-28	18-20	18-20	37-40
	C	C Sg + S. Clover	None	0-10	4-8	13-16	12-15	11-14	42-45	18-21	19-22	47-50
		Summer fallow Sg										
20	A	C Sg Sg	None	....	0-5	0-7	....	4-6	13-15	....	9-11	19-21
	B	C Sg Sg	20# N. on each Sg	....	0-7	6-12	....	8-10	21-24	....	16-18	32-35
	C	C Sg + S. Clover	None	....	4-8	10-15	....	9-12	37-40	....	17-20	42-45
		Summer fallow Sg										
22	A	C Sg Sg	None	4-6	4-6	6-10	11-13	9-11	18-20	17-19	14-16	26-28
	B	C Sg Sg	20# N. on each Sg	6-8	6-9	12-15	13-15	13-15	26-29	19-21	22-24	40-43
	C	C Sg + S. Clover	None	0-11	7-10	16-19	13-16	14-17	43-46	19-21	23-26	49-52
		Summer fallow Sg										
24	A	C Sg Sg	None	0-6	2-5	0-7	9-11	7-9	15-17	15-17	12-14	22-24
	B	C Sg Sg	20# N. on each Sg	0-8	3-7	6-12	11-13	11-13	23-26	17-19	20-22	35-38
	C	C Sg + S. Clover	None	0-9	4-8	10-15	11-14	12-15	39-42	17-20	21-24	45-48
		Summer fallow Sg										
27	A	C Sg Sg	None	7-10	2-5	8-11	13-15	8-10	19-21	20-22	13-15	28-30
	B	C Sg Sg	20# N. on each Sg	8-11	3-7	15-18	15-17	12-14	28-31	22-24	21-23	42-45
	C	C Sg + S. Clover	None	8-12	4-8	18-21	15-18	13-16	45-48	22-25	22-25	51-54
		Summer fallow Sg										
31	A	C Sg Sg	None	8-10	5-7	12-15	18-20	11-13	27-29	26-28	16-18	37-39
	B	C Sg Sg	20# N. on each Sg	9-11	7-10	19-22	20-22	16-18	37-40	28-30	24-26	52-55
	C	C Sg + S. Clover	None	9-12	8-11	22-25	20-23	17-20	55-58	28-31	26-29	61-64
		Summer fallow Sg										
32	A	C Sg Sg	None	7-10	4-6	8-11	13-15	9-11	19-21	20-22	14-16	28-30
	B	C Sg Sg	20# N. on each Sg	8-11	6-9	15-18	15-17	13-15	29-32	22-24	22-24	42-45
	C	C Sg + S. Clover	None	8-12	7-10	18-21	15-18	14-17	46-49	22-25	23-26	51-54
		Summer fallow Sg										

*Soils not listed are poorly adapted for crops shown.

†See text for discussion of growing conditions and systems of management used for these yield estimates.

‡C=Corn, Sg=Small Grain, S. Clover=Sweet Clover.

§Yields of crops shown are for Agar or Joe Creek part of Association; not for the Associated Lismas.

**Crop not adapted

high yields of corn and small grain, phosphorus deficiencies may become serious.

A base rate of 20 pounds of commercial nitrogen to the acre was used for yield predictions. In a favorable year, higher rates of commercial nitrogen can be profitably applied. In unfavorable years, nitrogen fertilizer will seldom give profitable yield increases.

Yield responses with nitrogen are usually greater for small grain than for corn in this area. Therefore, no direct nitrogen applications were made on corn in system B. The small yield increase given for corn in the tables under system B is a reflection of the residual effect of the nitrogen applied on each of the two preceding small grain crops.

In management system C, nitrogen and organic matter is obtained through the use of sweet clover. The small grains are in the most favorable positions with regard to moisture and nitrogen. Proportionate yield increases are indicated in the table.

Alfalfa and grasses are more suitable for long rotations on farms with livestock and are not so well adapted to short rotations.

In attaining the estimated yields in table 7, it is assumed that only disease resistant adapted varieties are used. Unadapted varieties may reduce the yield to a point where harvesting the grain would not pay.

Potential Irrigability of the Soils

The potential irrigability of the soils of Potter County is presented in table 8. It should be kept in mind in using this table that this classification is based on a reconnaissance survey, not a detailed survey. Because of the nature of reconnaissance surveys many delineations contain inclusions which are unlike the unit named.

The chief function of table 8 is to indicate lands which show promise for irrigation. Lands which are unsuitable (includes soils which are hilly, saline, wet, impervious, and sandy) can be eliminated and costly large-scale classification maps need be made only on those lands which show a definite ability to repay irrigation costs.

Land classification for irrigation, although based in large part on the physical, chemical, and slope characteristics of soils, is really an economic classification. This is because each class of land must be rated not only in terms of production under irrigation, but also in terms of its probable use and the income which will be available to meet land development costs.

Soils are classified in table 8 as to "potential irrigability." No economic analysis has been made to determine the income which would be available to meet land development costs. Moreover, no attempt has been made to determine if good land occurs in sufficiently large blocks to support irrigation costs.

The classification is based entirely on soil characteristics. The soils are placed in five groups—excellent, good, fair, poor, and unsuitable, based on the number of limiting factors each soil has and the intensity of the limitation. The limiting factors used in this classification are: unfavorable texture (either too coarse or too fine), shallow depth to incoherent sand and gravel, presence of a restricting claypan, shallow depth to the horizon of lime accumulation, shallow depth to alkali or salt layers, and unfavorable topography.

When classifying soils into potential irrigability classes, one must consider whether gravity or sprinkler type of irrigation is to be used. With the development of new techniques for sprinkler irrigation much land with topography unfavorable for gravity irrigation can be successfully irrigated using sprinklers. Future development of new methods of handling water and soils under irrigation may alter the ratings shown in table 8.

Table 8. Potential Irrigability of the Soils of Potter County

Soil Number	Soil Names	Potential Suitability for Sprinkler Irrigation	Potential Suitability for Gravity Irrigation
1.	Agar association, nearly level	Excellent	Excellent
2.	Agar association, gently sloping	Excellent	Excellent
3.	Agar association, sloping	Good	Fair
4.	Agar association, rolling	Fair	Unsuitable
5.	Agar-Lismas association, undulating and steep	Unsuitable	Unsuitable
6.	Agar-Raber association, undulating	Fair	Poor
7.	Agar, shallow over till-Raber association, hilly	Unsuitable	Unsuitable
8.	Agar, shallow over till-Zahl association, hilly	Unsuitable	Unsuitable
9.	Akaska association, nearly level	Good	Good
10.	Akaska association, gently undulating	Good	Fair
11.	Akaska association, undulating	Good	Fair
12.	Crandon association, hilly	Unsuitable	Unsuitable
13.	Estevan-Raber association, undulating	Poor	Poor
14.	Hoven association	Unsuitable	Unsuitable
15.	Hoven-Sage association	Unsuitable	Unsuitable
16.	Hurley association, nearly level	Poor	Unsuitable
17.	Joe Creek-Lismas association, undulating and steep	Unsuitable	Unsuitable
18.	Northville association	Poor	Poor
19.	Oahe association, undulating	Good	Fair
20.	Orman association, gently sloping	Unsuitable	Unsuitable
21.	Pierre-Lismas association, steep	Unsuitable	Unsuitable
22.	Promise association, undulating	Poor	Unsuitable
23.	Promise association, hilly	Unsuitable	Unsuitable
24.	Promise-Hurley association, undulating	Unsuitable	Unsuitable
25.	Promise-Hurley association, hilly	Unsuitable	Unsuitable
26.	Promise-Pierre association, hilly	Unsuitable	Unsuitable
27.	Raber-Agar, shallow over till, association, undulating	Fair	Poor
28.	Raber-Agar, shallow over till, association, hilly	Unsuitable	Unsuitable
29.	Raber-Agar-Estevan association, hilly	Unsuitable	Unsuitable
30.	Tetonka-Hoven association	Unsuitable	Unsuitable
31.	Williams association, gently undulating	Fair	Poor
32.	Williams association, undulating	Poor	Unsuitable
33.	Williams-Crandon association, hilly	Unsuitable	Unsuitable
34.	Williams-Zahl association, hilly	Unsuitable	Unsuitable
35.	Alluvial land	Poor	Unsuitable

AGRICULTURE OF POTTER COUNTY[6]

SOME OF THE characteristics of Potter County Agriculture are described briefly in this section, principally for readers not familiar with the county.

In 1950 the 553 farms of Potter County averaged 977 acres in size and occupied 540,272 acres of the 567,680 acres in the county. Of the land in farms, 54.8 percent was in cropland, 38.4 percent in pastures, and the remaining 6.8 percent in miscellaneous use.

Crops

The crop summary for Potter County for 1954 and averages for 1941 to 1950 are presented in table 9.

Livestock

Production of livestock and livestock products is an important phase of Potter County agriculture. The inventory numbers of livestock on farms for the past 10 years are shown in table 10.

Farm Tenancy

Farm tenancy in 1950 was 21.9 percent. Tenancy was 3.6 percent in 1890 and rose gradually to a high of 54.3 percent in 1940 and has been decreasing since that time.

Farm Values

The value per farm of lands and buildings was $26,500.00 in 1950. The average value per acre for 1950 was $26.00.

[6]All of the data appearing in this section were furnished by the South Dakota Crop and Livestock Reproting Service.

Table 9. Crop Summary: 1954 and Averages*

Crop	Acreage Harvested		Unit	Yield Per Acre		Production		Total Farm Value 1954
	1954	Average*		1954	Average*	1954	Average*	In Dollars
Corn, all	50,300	40,500	bu.	17.0	17.6	855,100	735,000	1,154,400
Wheat								
Winter	1,200	†	bu.	14.0	....	16,800	‡	....
Durum	100	400	bu.	5.0	9.9	500	3,000	....
Other Spring	92,300	85,900	bu.	9.0	12.8	830,700	1,086,000	....
All	93,600	86,300	bu.	9.1	12.8	848,000	1,090,000	1,919,000
Oats	36,300	21,500	bu.	22.0	29.0	798,600	617,000	479,200
Barley	4,000	35,600	bu.	20.0	17.8	80,000	667,000	74,400
Rye (for grain)	700	4,400	bu.	15.0	10.4	10,500	50,000	10,800
Flaxseed	7,700	3,100	bu.	3.5	7.0	27,000	23,000	82,400
Sorghums								
Grain	§	§	bu.	§	§	§	§	....
Silage & Fodder	§	§	ton	§	§	§	§	....
Potatoes	80	§	bu.	90	§	7,200	§	10,400
Hay								
Alfalfa	36,500	1,000	ton	1.20	1.20	43,800	1,000	....
Wild	75,000	63,100	ton	.55	.61	41,200	38,200	....
All	112,800	66,900	ton	.77	.64	86,500	41,900	1,270,900

*1941-1950 Average
†Less than 50 acres.
‡Less than 500 bushels.
§Not available

Table 10. Livestock on Farms: January 1 Inventory Numbers Cattle, Cows and Heifers, Hogs, Sheep and Lambs, and Horses and Mules, Potter County, South Dakota

Year	All Cattle	Cows & Heifers 2 Yrs. & Over: Kept Mainly for Milk Production	Cows & Heifers 2 Yrs. & Over: Kept Mainly for Beef Production	Hogs	Sheep and Lambs	Horses and Mules
	Number	Number	Number	Number	Number	Number
1946	27,500	3,100	7,600	27,700	11,400	2,700
1947	28,500	2,800	9,400	26,600	11,100	2,200
1948	29,500	2,400	9,700	23,900	8,000	2,000
1949	28,300	2,300	10,200	22,700	7,500	1,800
1950	37,500	2,300	11,700	27,700	8,200	1,700
1951	25,000	2,000	14,200	18,800	8,000	1,500
1952	29,000	1,900	16,100	21,100	8,500	1,300
1953	30,300	1,600	18,400	15,600	10,000	1,200
1954	32,700	1,700	*	14,200	10,100	1,100
1955	33,400	1,600	*	17,500	12,600	900

*Not yet available.

Organization and Population of Potter County[7]

POTTER COUNTY, which was named in honor of Dr. Joel A. Potter, an early territorial official, was created in 1873 by the Dakota Territorial Legislature.

The first written record of white men visiting the Potter County area shows that the Lewis and Clark Expedition in 1804 stopped at an Arikara Indian village at the junction of the Missouri River and Steamboat Creek.

The Arikara Indians who raised corn, beans, tobacco, and vegetables in this area were driven from the county about 1823 when fur traders burned their villages.

Potter County's first United States census was taken in 1890 and showed a county population of 2,910. A large influx of settlers took place between 1905 and 1910 and the population in 1910 was 4,666. In 1930 the population was 5,762 and this declined in the 1930's and early 1940's and was followed by a slight increase in 1950 when the census showed the population to be 4,688.

The Federal census classifies as rural all cities and towns with populations below 2,500. This classifies all of Potter County as rural although the 1945 State census, which includes as urban any town or city, showed that about 44 percent of the population lived in towns.

[7]Source: Potter County Agriculture, South Dakota Crop and Livestock Reporting Service.

This reconnaissance soil survey was prepared by W. I. Watkins, Former Associate Agronomist; G. J. Buntley, Assistant Agronomist; F. C. Westin, Associate Agronomist; and F. E. Shubeck, Associate Agronomist, of the South Dakota State College Agricultural Experiment Station.

Appreciation is expressed to B. L. Brage of the South Dakota State-College Agronomy Department for assistance in preparing the Soil Management and Productivity section of this report.

Soils were surveyed in 1950 by W. I. Watkins and J. U. Anderson, South Dakota State College Agricultural Experiment Station, and correlated by C. A. Mogen, Senior Soil Correlator, Soil Conservation Service, USDA, and the authors.

Published Soil Survey Reports

.... **Belle Fourche Area, 1908** (out of print—office copy available at Agronomy office)

.... **Reconnaissance Western South Dakota, 1911** (out of print—office copy available at Agronomy office)

.... **McCook County, 1924**

.... **Beadle County, 1924**

.... **Union County, 1924**

.... **Grant County, 1927**

.... **Douglas County, 1927**

.... **Walworth County, 1928**

.... **Moody County, 1929**

.... **Hyde County, 1930**

.... **Brown County, 1930**

B411 Jerauld County, 1951

B421 Day County, 1952

B430 Clay County, 1953

B439 Spink County, 1954

B449 Potter County, 1955

C88 Soils of South Dakota, 1951

Accessibility Statement

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

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

Nondiscrimination Statement

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

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

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

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

(1) mail: U.S. Department of Agriculture
Office of the Assistant Secretary for Civil Rights
1400 Independence Avenue, SW
Washington, D.C. 20250-9410;

(2) fax: (202) 690-7442; or

(3) email: program.intake@usda.gov.

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